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ANNALS of SURGERY

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CANCER OF THE LARYNX

IS IT PRECEDED BY A RECOGNIZABLE PRECANCEROUS CONDITION?

BY CHEVALIER JACKSON, M.D.
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THIS paper deals with the larynx only, and that but briefly. Its length would be increased to ponderous proportions if it were expanded to include even mere mention of the important corroborative examples of precancerous conditions in other regions of the body, even if the author had the ability and the time. The reader is referred to the masterful collection and analysis of pathological and clinical data on the subject by my colleague, Dr. W. M. L. Coplin.[1]

Fully recognizing the etymological and scientific faultiness of the word "precancerous," nevertheless it seems necessary to use it even if we must concede it a place little better than the algebraic "X." Disclaiming any attempt to maintain a brief for the word itself the author's clinical experience with cancer of the larynx leads him to the conclusion that cancer rarely if ever appears in the previously perfectly normal larynx. The chief objection to the term "precancerous" is that it will be loosely applied without a true anatomic basis, hence it is unscientific; but if it supplies the need for a word that will contribute to the education of the profession and the laity to the undoubted clinical fact that there is a class of morbid conditions in the larynx the cure of which will diminish the incidence of cancer, the use of the word is justified until some one suggests some other single word that shall serve the same life-saving purpose.

For all clinical purposes the term "precancerous" may be defined as any histologically abnormal condition intervening between the normal and the cancerous. It will not be disputed that such a condition exists, though there is room for widely differing views as to its frequency, because of the difficulties of its determination in any given case.

Fundamental to the acceptance of the view that there is a precancerous condition is the acceptance of the view that repeated injury and long-continued irritation and inflammation are potent causes of cancer. Present limits preclude consideration here of the evidence on this subject. Any one who is unwilling to accept this view is referred to the overwhelming evidence presented and ably analyzed by Coplin.[1]

Vocal Abuse as a Cause of Cancer.—It is my belief that prolonged vocal abuse can be a factor in localizing cancer in the larynx. It seems certain

that this factor has been overlooked and does not show in statistics, because, as a rule, vocal abuse itself is in most cases overlooked. In most statistics only professional singers and speakers and street-hawkers are recognized as abusers of their larynges; whereas, as a matter of fact, they constitute but a small proportion of the persons who suffer from chronic laryngitis, papillomata, granulomata and keratoses, as the result, wholly or partially, of vocal abuse. All statistics of cancer entirely overlook the vocational abusers who are compelled to force the voice in noisy and dusty places, the colloquial abusers, etc. Another factor preventing the statistical showing of a preponderance of professional voice users among cases of laryngeal cancer, is that the irritation caused by professional use is very much lessened by proper methods of vocalization. Still another factor is that persistent vocal abuse results in such a degree of impairment of the voice that the speaker or singer retires and the irritation ceases. Out of 582 cases of proven cancer of the larynx in my experience there had been undoubted vocal abuse in 376 (64.6 per cent.). Of the remaining 206 many should be classed as having abused their larynx, but these cases were not included because of incomplete records or some other factor that prevented absolute certainty. Of the 376 approximately one-half—187—(49.8 per cent.) were professional or vocational voice users. These included not only speakers, teachers, singers, hucksters, street-hawkers, sales-persons, foremen, drill-masters, etc., but mechanics and factory employees required to talk loudly in noisy, dusty places, and persons employed in many other vocations ordinarily little suspected of requiring excessive use of the voice. The balance, 189 (50.2 per cent.) used their voices for continuous conversation. They were of what might be called a colloquial temperament. By this term is meant the numerous class of people who talk practically all the time they are awake. If no listener is available they will hunt one; if none can be found they will talk or sing to themselves. Continuous phonation with them is a nerve cell habit whose cycle is the outlet for every efferent impulse excited by their daily contact with the world. Often my secretary, attendant, nurse and assistants have noticed that these people, though under my strictest orders not to talk, would, while waiting to consult me, needlessly talk all the time in the waiting room. Many of such persons are to be found among the vocational voice users who add this abuse to the vocational abuse. One form of vocal abuse not often recognized is talking, even though not loudly, in a dusty place. When talking every person is for the time a mouth-breather. Mouth-breathing is one of the well-recognized causes of chronic laryngitis.

That vocal abuse causes cancer is too broad an assertion. But that it is one of the commonest causes of chronic laryngitis, keratoses, papillomata and granulomata, is proven by experience; and that these conditions when perpetuated by vocal abuse and other causes can be a suitable soil for the development of cancer is, in my opinion, abundantly supported by clinical observation. The etiologic effect of vocal abuse is shown by the therapeutic effect of absolute silence. In the author's experience there is no other means to

compare with absolute silence in remedial efficiency in all forms of laryngeal disease. By absolute silence is meant the writing of everything that the patient has to say, even whispering being forbidden. Laryngeal lesions of the most widely varying character, such as lues, tuberculosis, benign growths, even cancer itself, will show local improvement under a strict silence régime. That the improvement in cancer is a lessening of cellular lawlessness cannot be maintained, but that the associated congestive, inflammatory and irritative phenomena are decreased to the extent of a lessening of the stenosis, has been clinically observed in the author's cases so frequently as to admit of no doubt. The author has often seen papillomata, granulomata, small œdematous growths and other benign inflammatory tumors totally disappear under silence treatment. It is my rule to enforce silence during the period in which I am studying a new case for diagnosis. Over and over again it has happened that the improvement and shrinkage in obviously benign growths has been so great that I have, in many cases, decided not to operate, and occasionally this decision has been rewarded ultimately by the total disappearance of the growths without other measures than absolute silence.

The bearing of all this on the present subject is that if we are prepared to admit that irritation is one known cause of cancer, and that vocal abuse is one cause of laryngeal irritation, the conclusion is obvious that vocal abuse deserves consideration as a precancerous condition.

Eversion of the Ventricle as a Precancerous Condition.—In using this term the author feels a very justifiable doubt as to whether or not there actually is a prolapse of the mucosa of the laryngeal ventricle. In using the term he refers to those cases in which what looks like a fold of normal mucosa can be tucked back into the ventricle with a probe. In two of the author's cases of this kind he felt justified in considering the condition as precancerous. In one of these cases a man who had an eversion of the ventricle first discovered in him by Dr. John Sterret, ten years later came to me with a fungating cancer on the same side as the eversion, the cancerous lesion involving part of the everted fold and part of the corresponding ventricular band. Removal of an ample specimen, which was examined histologically by Dr. Ernest Willetts, proved the cancerous nature of the lesion.

Lues as a Precancerous Condition.—In twelve of the author's cases of cancer of the larynx there was a luetic lesion preceding the cancerous lesion. Of these three were superficial, two fungating, two granulomatous, five ulcerative. Of the ulcerative lesions two were known to have started as gummatous lesions. In all of the cases the luetic lesion had been present many months, and in four of the cases had been made to disappear temporarily by the administration of mercury. Besides these cases in which laryngeal luetic lesions were precancerous, in many other cases there was a luetic history, and such cases seemed to me to be of a greater degree of malignancy. I am aware of the fact that the foregoing statistics do not warrant it, nevertheless my opinion is that lues favors cancer of the larynx. A number of other laryngologists have made the same observation. Mr. Tilley [2] states, " I have noticed that

a large proportion of my cases of epithelioma of the larynx have previously suffered from syphilis." My colleague, Doctor Coplin,[1] gives a most logical explanation of the connection between lues and cancer that seems to fit particularly well the clinical observations in my cases of post-luetic cancer. He states, "my thought is that the infection bears an etiologic relation because it is manifested by a reaction of irritation and not because there is what, under other conditions, might be regarded as any specific connection, between the tubercle bacillus, the treponema, blastomycetic fungus, various diphtheroids, cocci or other organism, and the new growth. In a manner resembling, but quite clearly different, the microörganism in some way liberates one or more toxic substances which irritate, frustrate repair, and lead to a lawless cellular proliferation similar to that following the continued irritation produced by soot, tar, pitch, paraffin or other substances possessing allied possibilities, and the irritation accompanying certain animal parasites. In this connection it is interesting to note that no infective process exclusively or even largely suppurative tends to tumor formation. The cytologic reaction in purely suppurative lesions, such as abscesses, is not reparative, it is protective; repair follows, and only when repair is constantly frustrated does the tendency to neoplastic evolution become manifest."

Keratosis and Leukoplakia of the Larynx as Precancerous Conditions.—Leukoplakia, so commonly precancerous about the mouth, I do not remember ever to have identified in the larynx, though I have seen conditions superficially resembling it. Keratosis, on the other hand, is relatively common and almost every laryngologist has seen cases in which a condition with the gross appearances of a keratosis has ultimately proven malignant. It seems logical to suppose that some, at least, of these cases were similar at some stage to Case IV, reported below.

Tonsillar Disease as a Cause of Cancer of the Larynx.—The tonsil has long been recognized as the fountain-head of a majority of the cases of disease of the throat. It has not, heretofore, been accused of causing cancer of the larynx. But we all know that a focal infection in the tonsil can be the chief etiologic factor in chronic laryngitis; and if we admit, as I think we should, that chronic laryngitis can be a precancerous condition, we must admit that a diseased tonsil can be a cause of cancer. Tonsillar disease is certainly often overlooked in persons of cancerous age. In one of the author's cases he overlooked a chronic infective condition in the tonsil and the lingual lymphoid apron, that was afterward discovered by Dr. T. R. French. In commenting upon the case Doctor French made the following statement: "Since I have been occupied in investigations of diseased lymphoid tissues in the throat my attention has, a number of times, been attracted to the disappearance of small neoplasms and inflammatory thickenings after removal of material containing pathogenic bacteria. As a consequence, I have long been impressed with the possibility of cancer being due to infection."

Benign Growths as Precancerous Conditions.—Here we enter on a subject upon which whole books have been written on the laryngeal phases alone. Sir Felix Semon, many years ago, in his exhaustive "Collective Investigations" showed conclusively that the repeated removal of a benign growth as a clinical fact had not been demonstrated to have caused cancer. This has never since been disproven. In Semon's day, the removal of a specimen was done by the indirect or mirror method of laryngoscopy, the technical difficulties of which were so great that a greater proportion of small and unrepresentative specimens were removed than is the case by the direct methods of to-day. As Jonathan Wright has said of such specimens, they might be "not even from the growth itself" in some instances. But even to-day it is no uncommon thing for the first specimen removed to show a papillomatous, keratotic, ulcerative or granulomatous histology, to be followed later by a specimen from the same larynx showing undoubtedly cancerous processes. This does not necessarily mean, however, that the cancer has been a sequel of the other processes. Papillomata, granulomata, and keratotic lesions are of inflammatory origin and may have coexisted with the cancer in a different part of the growth at the time the first specimen was taken. Irritation and inflammation may have been the original cause of both without necessarily a sequence. Moreover, once the barrier of a normal epithelial surface is broken, mixed pyogenic infections result in inflammatory processes. The author has seen a number of instances in which a cancerous ulcerative lesion has developed in adjacent tissue villous projections that grossly and histologically resembled papillomata rather than exuberant granulations. In such cases cancer may be said to be "prepapillomatous." The etiology of benign growths is a closely related subject of which space forbids full consideration. From his experience in benign growths of the larynx the author is convinced that the chief factor in the production of laryngeal papillomata, granulomata and hæmatomata is some form of irritation, including trauma and chronic inflammation. The limits of the present paper forbid the review of the data upon which this opinion is based. But it may be mentioned that the author has seen three cases of papillomata occurring in soldiers who had been gassed and who had suffered continuously with a chronic laryngo-tracheobronchitis. Mr. Tilley [2] reported a case of this kind before I had seen any of the cases mentioned.

Bearing of Location of the Lesion on Precancerous Conditions.—All statistics show a great preponderance of squamous-cell carcinoma in malignant disease of the larynx. While it is true that metaplasia to the squamous type may and probably does occasionally occur in cylindrical and glandular-cell carcinomata, yet this metaplasia is so rare and the clinical evidence is so conclusive that all must admit that one or the other vocal cord is the most frequent site of origin in cancer of the larynx. It is an indisputable fact that of all regions in the larynx the vocal cords are the parts subjected to the most irritation in practically every human being. It is also a well-known fact that benign growths appear most frequently at the site of greatest irritation,

namely, in the central zone of the anteroposterior extent of the cord. Recent observations by Ryland [3] show that it is this central zone that suffers most in fatally gassed soldiers.

Contact Cancer of the Larynx.—The author has seen two cases in which an isolated cancerous lesion developed on one cord at a point precisely opposite an isolated cancerous lesion on the other cord, both lesions touching during phonation. In neither patient was there any continuity between the lesions. In both patients the twin foci were histologically cancerous; one case ended fatally, the other is still living after thyrochondrotomy. These isolated twin foci have been noted by other laryngologists,[4] and have been referred to as "contact infections." It would seem logical to class them etiologically rather as the result of mechanical irritation of the first growth on the vulnerable epithelium of the opposite cord.

Histologic Appearances of Precancerous Conditions.—Here we encounter difficult perhaps insurmountable difficulties. Coplin [1] states in effect that in the production of cancer it may be assumed that the previously normal epithelial cell must have acquired not only the ability of proliferative invasion, but the ability to transmit to new cells the same power of proliferative invasion, a power which the normal epithelial cell did not possess. If such power were present but latent, then we must assume that something occurred to rouse the power and that this power is transmitted in most instances, from the original focus. It is this power that is the intangible thing that we all know is present but as yet not materially demonstrable, that presents the greatest difficulty in the study of precancerous conditions. Coplin [1] states: "Every discerning student of cancer must have apprehended reactions to irritation and other cell changes preceding cancer must be potentially malignant before it is possible by means at present available to demonstrate histologically the impending malignancy; a cell or tissue must be preparing, and finally must be prepared to infiltrate before the process is manifest. . . . Naturally a cell has made necessary preparations for doing a thing before it does it; histology rarely, if ever, tells us what a cell is going to do before it does it, although many of us are constantly deluding ourselves into the belief that we can deduce the future of a cell from a study of the past or present or both. . . . Much less can one tell what a cell is going to do when neither it nor any ancestor has yet done the thing in the particular case under investigation; the fact that other cells, in other cases, similarly situated, have followed certain or uncertain courses, may be suggestive, even helpful; but offers nothing conclusively applicable to any other case." Jonathan Wright evidently had the same thought in mind when he stated that it is too much to expect a prognosis to be based entirely upon histologic examination.

REPORTS OF CASES

Space permits the insertion of only a few cases. I have selected four that illustrate in a marked degree certain phases that were present in greater or less degree in many others.

Case I.—A man, aged sixty-eight years, was referred by Dr. Jacob Wolf. The patient had been continuously under treatment for ten years, for progressively increasing laryngeal disease, before coming under the writer's observation. Hoarseness had been present to a greater or less extent for five years. Progressive infiltration, worse on the left side, reduced the lumen to a narrow chink. The left cord was fixed. The author did a total laryngectomy. Histologic examination by Dr. Jonathan Wright showed the growth to be an endothelioma. Recurrence ended fatally one year after operation. The case is elsewhere reported in full.[5] It is alluded to here because of the long duration (eleven years) of infiltrative laryngeal disease. It seems altogether improbable that the growth was endotheliomatous from the beginning. The assumption seems warranted by the statements obtained from the laryngologists who treated the patient, that he had an infiltrative laryngitis as a pre-malignant disease.

Case II.—Male, aged fifty-five years, referred by Dr. John Dunn for consultation as to possible malignancy of the larynx. The patient complained of "soreness and stiffness" on talking and swallowing, and impaired voice, in varying degrees, for two years. He had been treated by various laryngologists for chronic tonsillar disease, chronic pharyngitis and chronic hypertrophic laryngitis for a number of years prior to coming under Doctor Dunn's observation. Internists had been able to reduce a blood-pressure of 200 to 145; and they had been able to control a chronic nephritis and a cardiac lesion. On mirror examination the larynx was found infiltrated and thickened evidently by a prolonged chronic laryngitis, the thickening in the posterior commissure being almost similar to that seen in pachydermia. The similarity was increased by small crusts visible below the glottis. The thickened hypertrophic mucosa rolled out of both ventricles on phonation in a way that would, I think, be regarded by some laryngologists as an eversion of the ventricle. The roll obscuring the region of the right cord was granular and roughened. No definite form of a cord could be made out on either side, and both sides overlapped on phonation, the sound of which was as rough and deep as if made with the ventricular bands, though these did not touch. Doctor Dunn, from mirror examination, regarded the laryngeal condition as probably cancerous. While the writer did not feel so strongly impressed in that direction it seemed to be a case in which a specimen might well be taken for diagnosis. This was, however, contraindicated by the fact that if the laryngeal condition were found histologically malignant operation would be inadvisable because of the patient's arteriosclerosis and his cardiac and renal conditions.

Three years later the patient was again sent by Doctor Dunn for consultation. The patient had pain in the larynx radiating to the ears, tenderness over the larynx and over palpable lymph-nodes on both sides of the neck. Dyspnœa was quite troublesome at night; but not so noticeable during the day except on exertion. Mirror examination showed the larynx narrowed by encroachment from both sides, and the anterior wall. On the right side there was a bulging mass of fungations from an ulcerated base occupying the location of the cord and ventricle. The glottis was occluded in its anterior portion. The mobility of both arytenoids was impaired. The condition was clearly inoperable not only because of involvement of the party wall and extensive lymphatic leakage, but because of the cardiac, vascular and renal conditions. Evidently radium offered the only hope of palliation, if the condition proved malignant; but it was also evident that enormous dosage would be required and such dosage would not be justifiable unless certain of malignancy. It was, therefore, decided that I should take a specimen. The histologic report of Dr. A. G. Ellis was "squamous-cell epithelioma."

Radium treatments were carried out by Dr. William S. Newcomet and had a decided effect in reducing the infiltration both in the larynx and in the neck. The lumen of the chink increased in area. The patient died of angina pectoris three and one-half years after Doctor Dunn first made the diagnosis of cancer, from laryngoscopic appearances.

Comment.—The progress of the case indicated the correctness of Doctor Dunn's mirror diagnosis of malignancy. The case was undoubtedly one of those slowly developing laryngeal cancers that run a protracted course, in this case over three years. Thyrochondrotomic removal could not have been adequate; laryngectomy, if not fatal, could not have given more than the five and one-half years the patient survived. The phase of the case that bears on precancerous disease is the long duration of a laryngeal irritation and hypertrophic laryngitis, from defective metabolism, vocal abuse, cigarette smoking, tonsillar disease, etc.

Case III.—Miss A. K., aged forty-nine years, referred by Dr. Preston M. Hickey and Dr. Herman H. Sanderson, for diagnosis of suspected malignancy of the larynx. The patient gave a long and interesting history of laryngeal disease.

The voice during childhood had been harsh at times so that people thought she had a "cold." At the age of twenty years the patient took up vocal training and the voice cleared so that for six years she sang mezzosoprano in church. For one year the patient gave singing lessons. At the age of twenty-nine years the singing voice was lost, and the speaking voice became increasingly hoarse. The patient then entered the Long Island Hospital for training as a nurse. At the age of thirty-one Dr. Thomas R. French saw her larynx. He has kindly furnished me the following notes: "Hoarse for two or three years, which she attributes to strain in singing. Throat easily tired on use of the voice. No pain. Larynx appeared normal in color and movements; but a small flat, very white growth (or crust) was noted below the anterior commissure." A beautiful water-color drawing of this growth was made by Doctor French. The growth was still present four months later. The left aryepiglottic fold was œdematous and later congestion of the left vocal band was noted.

At the age of thirty-three years the patient became aphonic. She then came under the care of Dr. Herman Sanderson, who found a papillomatous condition with a thickening of the left ventricular band.

At the age of thirty-seven years the patient being still aphonic, Dr. Chevalier Jackson, holding a clinic at the Harper Hospital in Detroit, removed a specimen from the larynx, which was reported as insufficient for diagnosis. At the age of forty-five, a degree of phonation was noted for a period of a year. At forty-six, the patient lost her voice every time she "took cold." The cords were noted by Doctor Sanderson as thickened but not red. At forty-seven, the voice was permanently lost and dyspnœa became noticeable. Dr. A. B. Wickham gave a series of violet-ray treatments which greatly improved the dyspnœa. Recently, however, the dyspnœa has reappeared.

At the age of forty-nine years, almost thirteen years after I first saw the patient, she was again referred to me by Doctor Sanderson for the taking of a specimen and the relief of the increasing dyspnœa which had become exceedingly distressing and was threatening asphyxia at night. Except for dyspnœa the general condition of the patient was good, she felt perfectly well, and had lost only three pounds in weight. There was marked indrawing of the guttural fossa and around the clavicles. Otherwise the general examination was negative.

Laryngoscopic Appearances.—Mirror examination showed nothing resembling cords. From the inner border of the arytenoids downward the larynx on each

side was filled with a nodular mass of tissue that obliterated the glottic chink except for a small triangular space posteriorly. Attempted phonation showed good movement of the arytenoids, but the movement brought no cords into view.

Direct Laryngoscopy and Removal of Specimen.—The dyspnœa having increased until tracheotomy was indicated, a direct laryngoscopy was done. The larynx was found infiltrated (though not hard) from the border of the ventricular bands downward. An ample specimen was removed with basket punch forceps, the tissue being soft and cutting easily; time, 1 minute 45 seconds. A second specimen was taken after 9 months, radium having been used in the meantime. Both reports follow:

Histologic Report, by Dr. B. L. Crawford. First examination: "Specimen consists of a fragment of tissue, measuring 0.75 cm. by 0.75 cm. by 0.5 cm.; weight less than 1 gm. One side is flat, apparently the base; the other aspect is rounded. A small spicule extends from one margin but does not appear to have a pedicle.

"Rapid technic.

"Histology: Sections show a diffuse infiltration of connective tissue and muscle by solid masses of squamous epithelium which has undergone no keratinization. In some areas marked leukocytic infiltration and hemorrhage can be seen. The mucosa is absent except at one margin of the surface.

"Diagnosis:—Basal-cell epithelioma."

Second examination:—"Specimen consists of a small irregular grayish piece of tissue measuring 0.75 cm. by 0.5 cm. by 0.25 cm. The tissue is friable.

"Formalin-alcohol fixation.

"Histology:—The small piece of tissue possesses a membrane of stratified squamous epithelium on one surface which is inflamed and ulcerated; on the opposite surface is a small strip of cartilage. The submucous tissue is extensively infiltrated by masses of epithelium. The infiltrating epithelium at site of ulcerated area is continuous with the surface epithelium, and there are also isolated nodules beneath that portion of the mucosa which is intact. The infiltrating epithelium shows little evidence of differentiation, for the most part the cells being irregular in shape and size; however, in places the cells resemble those of the prickle layer and in small areas show slight indication of keratinization. There is also extensive leukocytic infiltration throughout the tissue.

"Diagnosis:—Squamous-cell epithelioma."

Tracheotomy was done under local anæsthesia. Recovery prompt and uneventful.

The patient was then referred to Dr. D. Bryson Delavan and Dr. Thomas R. French for consultation. They decided to place the patient under the care of Dr. Douglas Quick for energetic treatment by radium. She is still under the treatment and is improved.

Comment.—Here is a case in which there was laryngeal trouble and vocal abuse for thirty years or more. Neoplastic conditions were present for at least thirteen years before the diagnosis of cancer was made. Over twelve years elapsed between the specimen reported insufficient and the one reported positively for cancer. It is impossible to say when the pathologic process took on malignant qualities. No one can regard the condition as malignant for thirty years. We must therefore grant that at some stage not yet cancerous the epithelial cells were preparing to sally forth on the invasion that we recognize histologically and clinically as cancer. *That stage was precancerous.* This fact is not altered by our inability to detect its presence in a given case.

Case IV.—A. R., male, aged forty-two years, had had hoarseness off and on for a number of years, the voice being normal or nearly so in the intervals. He had a chronic hypertrophic laryngitis for which he had been treated at various times for a number of years. About a year prior to consulting me an able laryngologist had noted on the centre of the right cord, "A limited patch of white thickening similar to a keratosis." The patient failed to appear for reëxamination until eleven months later when the same laryngologist noted that "practically the whole extent of left cord was replaced by a snow-white rough growth. The cord moved but appeared sluggish."

This was also the condition upon my first examination. (Fig. 1.) Prior to coming to me the patient had been seen by Sir St. Clair Thomson, Mr. Hunter Tod and Mr. Herbert Tilley. We were all of a similar opinion that while a benign condition such as a keratosis could not be excluded without histologic examination, yet the strong suspicion of malignancy warranted prompt action and especially so as the growth was extending toward the arytenoid region, where the chances of operative cure, if malignant, would be, to say the least, much lessened. It was, therefore, decided that Dr. Ellen J. Patterson and I should do a thyrochondrotomy, and, after splitting the thyroid cartilage, decide upon the question of how radical the removal should be. Doctor Patterson and I operated on January 3, 1916. The following is a copy of the report of operation:—

"When the larynx was opened the growth did not look manifestly malignant to us. There was no detectable infiltration, no extension downward beyond what might be called the lower limits of the cord. The slightly nodular appearance mentioned by Mr. Tod, and which seemed to us quite marked at indirect laryngoscopy, was not so much in evidence at thyrotomy. On the other hand it did not resemble any benign growth. The experience we all have had with growths of the clinical characteristics of this one led me to decide, in consultation with Dr. Patterson, to remove the entire growth with a wide base of normal. The growth, however, was so manifestly superficial that we did not deem perichondrial dissection with complete left-sided evisceration necessary.

"Dr. Ernest W. Willetts immediately examined the frozen section and his preliminary report on a frozen section was 'precancerous.'"

"Microscopic Examination:—The only pathological change noted in sections is confined to the epithelium. This shows very marked thickening with a tendency to form down-growths into the underlying tissue. Immediately beneath the epithelium there is quite a thick layer of lymphocytes and plasma cells which are seen particularly just underneath that part of the epithelium which shows the thickening.

"For the most part the epithelial tissue is sharply defined from the underlying tissue but at several points this is not so sharply marked. Some of the cells are atypical as to size and staining. At several points there appears to be beginning hornification within the centre of the epithelial plugs like the very first beginning of the epithelial pearls such as are seen in epidermoid carcinoma.

"Diagnosis:—Precancerous condition or possibly just beginning epidermoid carcinoma."

Doctor Willetts sent slides to Dr. James Ewing who reported as follows:

"Your laryngeal specimen is very interesting and rare. I have no doubt that you are justified in believing that this is one of the ways intrinsic cancer of the larynx begins. It may not be the only one. The sudden transformation from the normal to the hyperplastic and atypical epithelial pegs is very striking and at once sets the progress apart from inflammatory changes.

"I do not think the condition can at present be called cancer. It has not any of the essential features, not even sufficient atypical qualities of the cells.

FIG. 1.—The upper illustration shows a keratotic disease of the left vocal chord that seemed clinically so suspicious of a cancerous or precancerous condition as to warrant removal. The histological findings after the removal of the entire growth were not inconsistent with this clinical opinion.

The lower illustration shows the fact that at laryngo-fissure the extension downward usually seen in malignancy was lacking, and the growth was rather less granular in appearance. Only a moderate removal was decided upon. At the end of five years the patient was still free from recurrence and had a fairly good voice. (Photoprocess reproduction of an oil-color drawing by Chevalier Jackson).

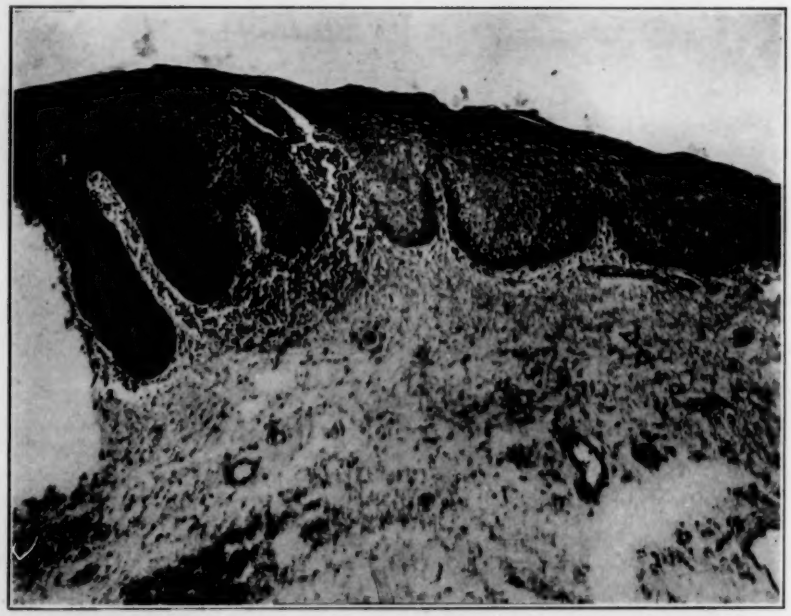

FIG. 2.—Extreme edge of pathologic process and approach to nearly normal contiguous mucosa. To observer's right slight reaction, some thickening of epithelial strata, and little increase in keratinized layer. Passing from left to right, just to left of middle of section, almost sudden change becomes obvious. Very notable overgrowth of epithelium which stains more deeply, often intensely, with loss of regularity and uniformity of cell arrangement and grouping; basal cells extremely polymorphous, of all sizes and without sharp, clearly cut, uniform border. Keratinization of outer stratum very marked near transition point and extending over more active area to left as well as over less changed tissue to right. At point of transition very intense mononuclear collections especially conspicuous between epithelium and old submucosa into both of which structures, however, mononuclear invasion occurs. Other sections showed more clearly and more conspicuously the changes mentioned, but were prepared by freezing, were not so well stained, and could not be photographed satisfactorily. (Photomicrograph from laboratory of James Ewing; tissue sectioned and stained by Ernest W. Willetts; legend dictated by W. M. L. Coplin.)

I have seen other beginning laryngeal cancers in which there was less overgrowth and more marked changes in the cells. I suppose the next step would be breaking away of the cells and invasion of the submucosa, but I should not expect this until the cells change their appearance considerably. This is the stage in which to treat cancer of the larynx, not after it gets well advanced." (Fig. 2.)

No sutures were used either in the cartilage or in the soft parts. The system of after-care originally devised by Doctor Patterson was skilfully carried out by her. The recovery was uneventful. The patient returned to England three months later and I have not seen him since; but a letter from Mr. Hunter Tod, eight months after operation, reported the larynx in good condition, with improving motility and favorable progress toward the development of an adventitious cord. The voice had returned and though still hoarse has lost the forced huskiness. I have heard through Dr. Herbert E. Smyth that the patient is alive and well.

Comment.—This case illustrates clearly and conclusively, I think, the value in laryngeal surgery of acting upon a clinical diagnosis of a precancerous condition. The case is a leading one in that the opinions of three eminent pathologists were to the effect, that, while the condition was not cancerous, and furthermore while they could not undertake to make any prognosis as to what the cells were going to do, yet they all seemed to regard the case as one in which they would not be surprised to see malignancy develop. In other words, they seemed to feel that the cells might be prepared or preparing to do something not already done, though the present limitations of histopathology would not warrant the positive statement of such an opinion.

This state of mind would seem parallel to that of the laryngologists concerned in the case. I believe every laryngologist of large experience can recall cases in which he regrets that he had not followed his undefined and undefinable feelings as to present or incipient malignancy in cases reported as histologically benign; and while it can, of course, in most instances be maintained on good grounds that there was malignancy in some unexamined portion, yet the clinical fact remains that had the laryngologist followed the guidance of an intuition born of clinical experience, the patient's life would have been saved. Just what constitutes the appearances in a laryngeal lesion that gives rise to a subconscious feeling of incipient cancer is difficult if not impossible to describe. In the same patient different laryngologists have given me quite different phases of the lesion and its history as the basis of their opinions, notwithstanding the fact that their opinions coincided as to the suspicions of malignancy.

Notwithstanding the fact that it would be manifestly out of the question for any pathologist to say on the basis of an examination of a removed dead cell what the adjacent living unremoved cells were going to do, I feel that the histologic appearances here go far to corroborate the clinical view that there is a curable precancerous morbid state that precedes malignancy in many cases of cancer.

Treatment of Precancerous Conditions.—As Coplin[1] has so well said: "The practical application of our recognition of irritation as a frequent antecedent of malignant disease becomes obvious. It is not necessary to assume

that there is a specific tumor excitant, cytologic, microörganismal or chemical, but that cancer often arises under influences the nature of which we cannot at present accurately define, but which tentatively may be termed irritative, fully recognizing how vague and unsatisfactory the designation must be. Fortunately, for practical purposes this particular indefiniteness is no impediment to our understanding the application to prevention and treatment. Every delay in healing of any non-suppurative process in which the normal tendency to repair is unduly prolonged, no matter where—skin, mucosa, lip, eyelid, tongue, stomach, intestine, rectum, bladder, mamma, vulva, uterus, prepuce or elsewhere—every irritated gland, wart or mole, becomes a source of suspicion."

My experience in clinical laryngology leads me to believe that this clear and concise statement applies with especial force to the larynx.

If the author's views are accepted, the cure of chronic laryngitis becomes of fundamental importance. Unfortunately we are confronted at the outset by two obstacles in dealing with persistent intractable chronic laryngitis.

1. The difficulty of obtaining absolute rest for the larynx, especially in the cases due in part or wholly to occupational vocal abuse, dusty occupations, cough of extralaryngeal origin, and the like. Even the normal respiration of the dry overheated dusty atmosphere of the average dwelling in the United States is injurious to the individual larynx, peculiarly susceptible to such irritations.

2. Laryngectomy leaves the patient in such a deplorably crippled condition that we cannot consider for a moment the total removal of an otherwise incurable chronically inflamed larynx only suspected of being potentially cancerous, as has been so wisely urged by Bloodgood [6] in parallel cases of chronic mastitis. Nevertheless, the study of the case will usually find which causes, among the many, of a chronic laryngitis are operative; and having found them a cure will follow. Tonsillar infective diseases are well known factors in the production of chronic laryngitis. The writer was particularly struck with the discovery by Dr. T. R. French of a chronic tonsillar disease of long standing in the case reported here as Case IV; and his comments thereon are important.

Keratoses and similar overgrowths of epithelium occurring in adults are to be dealt with as potentially precancerous. The opinion of Dr. James Ewing commenting on the histology of a specimen in one of the author's cases (Case IV, above), namely that "this is the stage in which to treat cancer, not after it gets well advanced," in my opinion expresses such a great clinical truth in such a great way, that it encourages me in making a plea before this Association for the clinical recognition of a precancerous condition. And while I realize that we cannot now definitely lay down specifications and descriptions of precise characteristics by which a precancerous condition can be identified in a given case, I think it will be a step toward the ultimate attainment of such an ideal if we begin by recognizing the fact that there exists a group of cases not already cancerous in which the malignant

possibilities are so great as to justify wide removal of normal tissue surrounding the base of the lesion. The general surgical rule, applying to individuals past middle life, that benign growths exposed to irritation should be removed, probably applies to the larynx as well as to any other epithelialized structure. In regard to papillomata, however, radical surgery and radium burns from excessive dosage are to be avoided as disastrous to the voice and the lumen of the airway as well as quite unnecessary for cure. Superficial removal and avoidance of all irritation such as tobacco-laden or dusty atmosphere, vocal abuse, the cure of tonsillar infections (see Doctor French's comment in Case III) will effect a cure with excellent vocal results. The author's case records show numerous instances in which papillomata, granulomata and œdematous polypi of the larynx have shrunken and in many instances disappeared by the sole influence of absolute silence.

CONCLUSIONS

1. While there is here offered some evidence bearing on the histology of precancerous conditions, this evidence is not conclusive.

2. Clinical work is not, and never can be, ideally perfect. We are human and our patients are human. We cannot expect in our clinical work on the living human being to attain even to the relative certainty of the post-mortem room.

3. As laryngologists we are concerned with saving human lives from the inroads of a "dire disease," which is the appellation applied to cancer of the larynx by Sir Henry Butlin.

4. If we admit, as I think we should, that certain curable laryngeal conditions are in some cases the sequential predecessors of frequently incurable cancer, it is clearly our duty not only to eradicate those curable precancerous conditions, but to contribute to their early recognition by applying to them the term "precancerous," however faulty such a word may be from a purely scientific, histologic point of view.

5. From a clinical point of view we may regard continual laryngeal irritation from any cause, chronic laryngitis, keratosis, syphilis, pachydermia, so-called prolapse of the ventricle, and benign growths, occurring in a person of cancerous age, as clinically precancerous, in the sense that they may be contributary factors in the etiology of cancer, and as such should be cured, surgically or otherwise, as may be indicated.

6. It is no argument against this life-saving rule to contend that these conditions are too rarely predecessors of cancer to justify regarding them as etiologic factors in cancer. There is no known agent causative of any disease that will always, in all individuals, under average conditions of exposure, produce that disease. The human race would be extinct if such were the case.

7. The time has come for the laryngologist to follow the lead of the general surgeon and the gynæcologist in the recognition of the necessity of curing cancer before it starts.

8. There will be fewer deaths from laryngeal cancer when every mem-

ber of the medical profession fully realizes the frequently malign nature of chronic hoarseness.

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ARTERIAL DECORTICATION

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In 1918, Professor Halsted interested me in what was then the comparatively recent work on perivascular surgery, reported by Réne Leriche, of Lyons, France. An interesting observation on surface temperature, which bore definite relationship with certain features of interest in Leriche's work, was made at that time in the Surgical Clinic of the Johns Hopkins University.

The following are extracts from Doctor Halsted's reported case,[17] in which he ligated the left subclavian and carotid arteries near their origin from the aorta, for the cure of a huge, left subclavian aneurism. Two years after this proximal ligation, the aneurism developed a pulsation and grew larger, at which time the patient reëntered the hospital and had it excised. The point of interest to this discussion is the fact that several hours after the excision of the aneurism it was noted that the left hand and forearm, which for the preceding two years had been strikingly cold, had now become abnormally warm, appreciably warmer than the corresponding limb on the sound side; and it was further noticed that the hand remained warm for several weeks after the operation. This rise in surface temperature over that portion of a limb distal to the complete removal of a segment of artery is one of the interesting phenomena which Leriche reports as following his operation of arterial decortication.[37] This hyperthermia he attributes to the vasodilation which, he says, accompanies removal of the sympathetic nerve plexuses about an artery. Any excision of an aneurism would necessitate, of course, the complete removal of these fibres, if such be present.

In a long series of papers, Leriche has called attention to sympathetic nerve plexuses which are said to lie in the intimate sheath of the large arteries and in the adventitia of these vessels, and he specifies that certain definite results follow the excision of these structures in the treatment of different syndromes. The surgical removal of these structures, an operation called by him "Sympathectomy,"[27] was conceived, proposed and accomplished in 1889 by his teacher, Jaboulay,[24] who performed it with curative results on the femoral artery in certain perforating ulcers of the foot, and to a less successful degree, on the cœliac trunks in certain visceral disturbances, the nature of which has not been ascertained. Before considering the rôle which the sympathetic fibres are said to play in these clinical pictures, we will enumerate the steps in the operative procedure.

TECHNIC OF THE OPERATION

Leriche has designated his operation as an "Arterial Sympathectomy," according to the arterial level at which it is performed, axillary, brachial, iliac, or femoral.[27] The main arterial trunk is exposed by the classic route of

access a considerable distance proximal to the part affected. Thus the brachial artery is the operative site of election for disturbances in the forearm and hand, and the common or superficial femoral arteries for lesions in the foot or leg.

The external fibrous sheath covering the artery is incised for a distance of eight to ten centimetres, and the artery, with its inner, more intimate sheath and its adventitia, is now exposed. This inner sheath, which is fused with the adventitia of the artery, is grasped with tissue forceps and is incised directly on the vessel wall. Traction is maintained on one of the lips of the sheath of filmy tissue thus isolated, and this structure is completely freed from the artery over the length of the incision with a knife or fine scissors. The artery is in this manner stripped of its external coat, together with the fibrous tissue which is adherent to it.

Occasionally, one is able to remove only small cellular fragments of this external layer, but at other times definite laminæ may be dissected away. Leriche lays much stress on the complete removal of the thin meshes of loose tissue which adhere to the body of the artery, and the thoroughness of the removal of these strands is seen when the artery is gently swabbed with a moist gauze. With the artery thus moistened, it assumes a whitish, felt-like appearance, and the more or less detached débris, which clings to it, is easily seen. This arterial decortication is continued until the main body of the artery appears as a smooth homogeneous surface.

In the course of the operation, one is required to expose any collateral branches present in order to guard against their injury. Should these require ligation, we have found it prudent to ligate them at some little distance from the parent trunk in order that the decortication be completed without stripping these ligatures. In several of the cases here reported, the exposure of the operative field and the ease and safety of manipulation have been facilitated by grossly freeing the chosen segment of artery from the neighboring structures over the requisite distance, cutting the collaterals where necessary, and leaving the artery and its intimate sheath for the time being intact. A sheet of rubber tissue may then be drawn under the artery from side to side and clamped to the four corners of the wound, after which the more minute dissection of the artery is completed. Certain objective reactions in the hands of Leriche and his compatriots have been found to follow and be consequent upon this procedure.

POST-OPERATIVE OBJECTIVE REACTIONS

1. *Reaction of Visible Arterial Contraction* [27].—As an immediate consequence of the denudation of the artery, a diminution in its calibre takes place until it has progressively reduced in size during the operation to that of a small, whitish cord, reminding one of a nerve trunk. In our series of ten decortications, five on the femoral and five on the brachial arteries, we were able to verify this and Leriche's further observation that the arteries of larger calibre were much slower in their contraction than the smaller. We

found indeed that the femoral artery was rarely much reduced in calibre. In two of these femoral cases no contraction whatever in the artery took place.

In the decortication of the brachial arteries only did we notice that pulsation could be neither seen nor felt as the operation progressed, a fact due to the local constriction of the vessels in the operative field. In two instances, the pulsations disappeared over the distal portion of the artery, while it could still be made out in the proximal area. Toward the end of three of the operations on the brachial artery, pulsation was seen to reappear.

2. *Reaction of Vasodilation with Hyperthermia* [27].—Whereas Leriche constantly found a post-operative increase in surface temperature over those parts distal to the decortication, we were able to ascertain this in but one patient. He stated that this increase in temperature was at times noted on the evening of the operation, more often on the following morning, but usually occurred thirty-six hours after the operation, and marked the onset of the reaction of vasodilation.

In most of the instances recorded by Leriche, the local hyperthermia disappeared about the fifteenth day after the operation, a fact which illustrates the transitory character of the reaction. In connection with this previously mentioned case of Professor Halsted may be mentioned a patient in whom a quadruple ligation and excision of the sac was performed for the cure of an arteriovenous aneurism of the axillary artery.[2] The forearm and hand of this patient were much warmer four months after the operation than those on the sound side.

Lesions, other than those mentioned, may result in an elevation of surface temperature. This may occur in the upper extremity following injury to the median and ulnar nerves, and it is probable that such lesions injure the sympathetic fibres which course in the nerves and which are destined for the skin capillaries. Vincent [2] has observed hyperthermia in the arm of a soldier, who was injured in the axilla and who presented signs of lesion of the median and ulnar nerves, and in whom, at operation, was discovered injury to the brachial plexus. Gorodiche [2] reports a patient with hyperthermia of the forearm and hand, who was wounded in the inner aspect of the upper arm ten weeks before, and who showed symptoms of injury to the median nerve. This hyperthermia definitely exceeded the boundary of the sensory field of this nerve.

3. *Reaction of Increased Peripheral Blood-pressure* [27].—Leriche reports a constant post-operative rise in the systolic pressure distal to the point of operation, but we have been unable in any of our cases to verify this observation. He has found an increase of as much as 40 mm. of mercury, and states that the maximum elevation of pressure is reached on the second or [illegible] day. This local hypertension becomes attenuated in the days that follow, until it is completely dissipated about the same time as in the excess surface temperature. His estimation of diastolic pressure showed no pronounced variation. His observations were made with a Pachon oscillometer

and his readings were taken at the malleoli and at the wrists, where the dressings interposed no variation.

Claude Bernard [7] suspected that the greater accumulation of blood in a part would lead to hyperthermia resulting in an increase in blood-pressure. In order to study the action of the sympathetic fibres going to the head, he conceived a method of differential mercury manometry, and was able to indicate by a simple difference in mercury level all modifications of pressure in two symmetrical arteries of the face. He made his experiment upon a horse, and his manometer consisted essentially of a U-tube with branches partially filled with mercury. One end of this instrument was joined by a tube to the right labial artery and the other to the left. Under normal conditions the manometer was at rest and the mercury remained at the same level in both limbs. When, however, the cervical sympathetic chain on one side was cut, the pressure in the manometer on that side rose, and the difference in pressure between the two sides in five experiments measured respectively, 40, 60, 60, 31 and 25 mm. of mercury. It may be worthy of note to here mention the fact that upon galvanization of the distal cut end of the cervical sympathetic, the distal, as well as the proximal portion of the cut artery, contracted. This is definite proof that the vasoconstrictor fibres of the sympathetic system in the head do not travel along the artery, but reach it at different levels.

This local hypertension is based by Leriche on the theory that the vasodilation, which accompanies the decortication, permits a greater quantity of blood to be propagated to the periphery, and this increased flow results in an increased head of pressure.

THEORY OF MODES OF INJURY TO THE SYMPATHETIC FIBRES

Trauma of some sort to the sympathetic fibres is claimed to be the causative factor in the clinical condition which Leriche relieved by this operation. According to him, the fundamental trouble is a disturbance in the vasomotor innervation, with a resulting vasoconstriction forming the basis for the syndromes. His basic assumption is that sympathetic vasomotor fibres course along and ramify in the periarterial nerve plexuses of the extremities. He designates three possible varieties of trauma which result in the disturbance of the vasomotor balance of the extremities, and are the cause of certain definite clinical pictures.

The mechanism of the first mode of injury assumes trauma to the afferent spinal nerve fibres in the tissue of the extremities not necessarily in the immediate vicinity of the vessels or nerves. Traumatic excitation of these sensory fibres conveys impulses which travel to the ganglionic and medullary centres, which cause a reflex vasoconstriction of perhaps the whole extremity. On the basis of this traumatic reflex vasoconstriction, he explains a case in whom there was a definite pre-operative hypothermia proximal to the level of the area traumatized. This patient was injured in the lower third of the superficial femoral artery, but the lowering of the surface temperature was noted as high as the gluteal region.

In the second variety of trauma, he states that vasoconstriction in a distal part may arise, not by reflex action, but by direct injury to the efferent sympathetic fibres, which are said to lace the arteries with a periarterial network. When these are traumatically irritated but not destroyed, they overact and convey stronger impulses to the periphery than normal, a phenomenon which results in increasing the vascular tone to the point of vasoconstriction, resulting in hypothermia.

He theorizes still further on another variety of injury to the efferent sympathetic fibres in these arterial plexuses, which is destructive in its nature. This destruction of the vasoconstrictive element, which he thinks preponderates, results in a paralytic vasodilation and hyperthermia. It is by this third mode of injury that Leriche would explain the hyperthermia that followed the excision of the subclavian aneurism in Doctor Halsted's patient, since the efferent fibres accompanying the artery were of necessity sacrificed when that portion of the artery containing the aneurism was resected. The vasoconstrictor element is the more prominent in the first two types of lesion, resulting in hypothermia, and the vasodilator element preponderates in the third variety, with a consequent increase in surface temperature. This complex vasomotor situation, however, may be further complicated by the reduced quantity of blood going to the extremity as the result of partial or complete obliteration of the artery, as well as by the consequences of immobilization of any muscles which may be paralyzed. Thus it may readily be seen from the imagined variety of lesions and the amount of possible injury to the artery and nerve, that there may result all gradations from hyperthermia to hypothermia. In cases of decreased, as well as those of increased surface temperature, however, it is noted that there has been a tendency for the normal thermal equilibrium to become established, and Leriche thinks that this restoration of vasomotor balance is brought about by a reëstablishment of the sympathetic nerve continuity by means of the plexuses on the collateral arteries.

In all of the patients for whom he claims relief, he has noted, before the operation, a hypothermia of the affected extremity, which he explains on the basis of a traumatic vasoconstriction. The fundamental point in his therapy is the restoration of vasomotor balance in the part. This restoration he claims to accomplish by excising normal sympathetic fibres from the parent artery of the affected extremity at a point proximal to the lesion.

CLINICAL PICTURES OF THE DISORDERS CURED BY LERICHE

We cannot compare our results with those of Leriche, since none of our cases correspond to those in whom he obtained such spectacular cures. In his hands the operation was successful in a number of unassociated clinical pictures of a rather vague description, but which he considers have in common a disturbed vasomotor balance.

1. *Traumatic Disorders of Babinski-Froment Type* [18–24].—The clinical picture described by these men develops after minor injury to the limbs

involving only the soft parts, and the severity of the lesion is not at all proportional to the intensity of the symptoms. Clinically, the disease is described as presenting a definite syndrome which includes contractures and pareses, which develop almost immediately after traumatism.

The motor changes are accompanied by none of the objective signs characteristic of typical organic affections, such as follow lesions of the central nervous system or large vessels. They resemble in many features manifestations of hysteria and one who has not seen but has merely studied reports of this condition, is forced to note this similarity. Unlike hysterical phenomena, however, these patients resist counter-suggestion.

In addition to contractures and pareses, the complete picture may present muscular atrophy, exaggeration of the knee-jerks, and changes in the cutaneous reflexes, together with disturbances in objective and subjective sensibility. Vasomotor, secretory and trophic disturbances are noted in the bones, skin, hair and nails. French neurologists admit that its pathogenesis is still unsettled, but claim that these disorders, whatever names they may receive, constitute a special group, half-way, as it were, between organic affections on the one hand, and hysterical phenomena on the other.

Leriche considers that these symptoms arise from injury in the depths of the tissue, to the sensory and motor terminals as well as the sympathetic fibres, and that from such injury there may result an infinity of small nerve lesions which reflexly result in the vasoconstriction responsible for the condition.

2. *Causalgia of Weir Mitchell* [51].—Another rare but well-recognized clinical picture, which has yielded to arterial decortication in Leriche's hands,[25] is the causalgia of Weir Mitchell. This syndrome in essence is a painful form of neuritis of the median nerve and described by him during the Civil War and called " Causalgia," from the Greek, meaning " I burn." Its causative factor is trauma and the predominant symptom is pain. In this clinical picture the elbow is flexed, the wrist slightly radially curved, and the hand raised with the fingers extended, with occasional hyperextension of the terminal phalanges. The hand is emaciated and atrophied, making the fingers thin and tapering. Motor disturbances are usually slight and total paralyses are consequently few, although slight weakness in movement is sometimes made out.

The subjective sensory disturbances are the most distressing symptoms, and paroxysms of pain usually occur a few days after the wound is inflicted. This pain is moderate in intensity in the early stages of the disease, but progressively increases. The patient refers it to a semicircle extending from the root of the thumb to the root of the index or middle finger, and it reaches its height four or five months after injury, when it very slowly diminishes in severity.

In considering the mechanism of causalgia, it is probable that we are dealing with trauma to the fibres of the sympathetic system which accompany the median nerve, and which supply the glands, capillaries, and nerve endings

of the different layers of the skin. It has been suggested also, that the symptoms may be the result of injury to the nutrient artery of the median nerve,[9] together with lesion of the sensory fibres in this trunk. Complete cures of this condition have followed decortication of the brachial artery.

3. *Results of Excision of Obliterated Arterial Segments*[37].—In limbs affected by arterial obliteration due to trauma, a variety of vasomotor, motor and sensory disturbances ensued. At operation is found an impermeable fibrous cord, or the remains of scar tissue, in which the artery cannot be recognized. With the removal of this obliterated segment, however, Leriche has noted marked improvement in these cases, and he concludes from this fact that the fibrous cord of an artery is not an indifferent structure, but is a real nerve, whose functions, due to injury to the perivascular nerves, have become perverted.

4. *Spontaneous Ulcers in Amputation Stumps*[32].—Certain ulcers which occur in amputation stumps over areas where there is no pressure, and which are definitely not caused by infection, are very refractory in their treatment. In this condition the affected stump is cold and œdematous, and any granulations present are very friable. The lesion begins as a vesicle, which later bursts and becomes an ulcer. It shows no tendency to heal but continues unimproved over months and renders the use of apparatus impossible. According to Leriche, after decortication of the femoral artery, several of these ulcers have closed promptly, and their scars have remained resistant enough to bear the use of apparatus.

FUNDAMENTAL DETAILS OF THE AUTONOMIC NERVOUS SYSTEM

Since Leriche states that both the mechanism of production of these lesions and that of their cure rest upon the involvement of the sympathetic fibres, it is fitting that we review the fundamental physiologic and anatomic bases governing these fibres before we go further.

As there has been much loose teaching and writing concerning the autonomic nervous system, of which the sympathetic division is but a part, and as there is some controversy about the paths along which the fibres of this division run, a portion of this paper will be devoted to considering our present knowledge on that subject. No apology need be made for summarizing Langley's admirable survey[23] of the subject, since the facts which have accumulated are so numerous that it is imperative to try to coördinate them, and since results published on trivial evidence and faulty premise serve but to obscure the issue when no general scheme is borne in mind.

The autonomic nervous system includes the motor nerves which control the activity of the unstriated and cardiac muscle tissue and all glandular structure, and its several divisions take their origin from separated portions of the central nervous system. All of these efferent autonomic fibres leave the spinal cord in four regions, each of which is separated from the other by areas in the brain and cord, from which no autonomic fibres pass. Since the mid-brain, bulbar, and sacral autonomic divisions have no connection with

the sympathetic autonomic fibres which supply the extremities, we will confine our attention to the sympathetic section of this great system. The cord cells of the sympathetic autonomic division lie in that portion of the spinal cord from the first thoracic to the second or third lumbar segments, inclusive; and it is with the fibres of this division that we are especially concerned in this paper.

To properly appreciate the peripheral course of the sympathetic fibres, we must be familiar with the nerve unit of the sympathetic division. In common with the other divisions of the autonomic system, this unit consists of a central and a peripheral neuron. The central of these neurons for any given segment has its nerve cell in that segment of the cord, and this cell sends out its axon from the cord by way of the anterior root of the corresponding spinal nerve. This axon is a medullated nerve fibre and outside of the cord it emerges from the anterior root to end in one of the ganglia of the sympathetic system, and is therefore called the pre-ganglionic fibre of that particular unit. This axon leaves the anterior root in company with other similar axons from similar cells in the same spinal segment, and they leave the anterior root in a trunk which is called the "white communicating ramus." This ramus is white because this group of pre-ganglionic fibres are medullated.

The sympathetic ganglia, about which these pre-ganglionic fibres form connections, are essentially groups of nerve cells of the peripheral neurons, whose function it is to give off non-medullated axons, known as the post-ganglionic fibres. These fibres are grouped into trunks of fibres, each of which courses back to the root of the corresponding spinal nerve, and this trunk is known as the "gray communicating ramus," from the fact that the post-ganglionic fibres which are contained in it are non-medullated.

The sympathetic ganglia of the sympathetic division are divided into two groups, the paravertebral, or lateral sympathetic chain of ganglia, and the prevertebral, or the co-lateral system of ganglia. Since we are engaged in the study of those fibres which run to the extremities only, we are not concerned with the prevertebral ganglia, from which emanate fibres which run to the viscera. The common characteristic, then, of all of the lateral ganglia is that each of the nerve cells there contained sends its post-ganglionic fibre back to the cerebral spinal nerves to be therein distributed to the body wall and the extremities.

Course of the Sympathetic Fibres to the Skin of the Extremities.—From what has just been said, we know that the fibres which run to the skin of the extremities leave the lateral sympathetic chain by way of the gray, non-medullated, post-ganglionic fibres, and course to their destination *via* the spinal nerves. Thus these fibres are contained in the cutaneous branches of these nerves, and run with them to the skin, a fact of dominant interest in this discussion. It has been generally believed that some sympathetic fibres make their way to the periphery along the sheaths of the arteries, but definite proof that they follow the arteries has not been adduced.

Indeed, it is the opinion of physiologists that the course in the cutaneous

nerves is the correct one. There is this point, however, to be borne in mind, that the sympathetic system does send fibres direct to the aorta, and that these appear to spread some distance down along the larger arteries. It is not unlikely that these nerve fibres cause some contraction in these vessels, and that in this way a modification of the blood supply to the skin and to the muscles may take place without any direct action on the peripheral vessels.

Course of the Sympathetic Fibres to the Skeletal Muscles.—Since we have seen that the gray rami, which run to the spinal nerves, contain sympathetic fibres which are destined for the innervation of the skin, we may expect that also in these gray rami go the fibres which supply the muscle, and that these muscular nerves send vasomotor fibres to the arteries in the muscle.

HISTORIES OF CASES OPERATED IN THIS SERIES

CASE I (Group 1).—E. H., male, age thirty-eight years. *Complaint:* Pains in the left hand and right foot.

Present Illness and Local Condition.—The patient has suffered since boyhood from chilblains and numbness of the feet in winter. Six years ago the small toe of the right foot became gangrenous to the middle phalanx and the toe was amputated. Gangrene next affected the third toe on the right foot, and amputation followed. Later the leg was amputated at the ankle. Two years later all toes of the left foot became gangrenous and the foot was amputated at the tarsometatarsal joint. After one year, the index finger of the left hand became gangrenous and was amputated. One year previous to admission in October, 1921, the stump of the left leg began to slough and the leg was amputated below the knee. Upon entering the hospital this stump was again affected and was amputated at the upper third of the thigh. The arteries in all extremities showed normal pulsation.

Operation.—Decortications of the right femoral and the left brachial arteries were performed in the effort to stop the ascending gangrene. *Result:* The gangrene in both operated extremities gradually progressed until his death one year later. *No improvement.*

CASE II (Group 1).—P. O., male, age forty years. *Complaint:* Pain in both lower extremities, for the most part confined to the large toes; ulcerations on the mesial surface of both large toes and violent color changes in the feet.

Present Illness and Local Condition.—Four years ago the patient first noticed numbness and pain in both feet while on the march. A short time later two deep ulcerations occurred, one on the mesial surface of each great toe, and all attempts to heal these ulcers by hydrotherapeutic and orthopædic measures were without avail. Peripheral arterial pulsation normal.

Operation.—Bilateral femoral decortication and left brachial decortication. *Result:* Marked improvement immediately followed the operation in the lower extremities, as evidenced by the disappearance of the disturbed color changes and the healing of the ulcers into scars. But these scars later broke down and the ulcerations reappeared. For some time an improvement was noted in the left hand and arm, but the pain soon reappeared and the condition is now as before the operation. *No improvement.*

CASE III (Group 1).—E. D., female, age sixty-three. *Complaint:* Paroxysmal pain in fingers of left hand, radiating up left arm.

Present Illness and Local Condition.—Twenty years ago both hands were numb, blue and white at intervals, especially on cold mornings. The condition has gradually become worse in the last ten years, until a year before her admission to the hospital in August, 1921, the finger tips on the right hand, and a little later

on the left, grew painful and tender, and small suppurating areas appeared beneath the nails of all fingers. The local points of suppuration of the middle fingers of both hands were followed by gangrene, resulting in self-amputation of the terminal phalanges of these fingers. Pulsation was normal in all extremities. About the stump of the left middle finger was a puffy, œdematous area, with a ring of very pale skin adjacent to a distal gangrenous slough. The entire left hand was much more tender than the right.

Operation.—Typical decortication of the left brachial artery. *Result:* For some days after the operation the pain was diminished and the color changes in the skin were less marked. The pain, however, later became more severe and it was evident that the gangrene was spreading. For this reason the last three fingers of the left hand were amputated at the metacarpal-phalangeal joints, together with the terminal phalanx of the index finger. *No improvement.*

Case I (Group 2).—C. E., male, age sixty-three. *Complaint:* Pain and ulceration over the dorsal surface of the middle toe, left foot.

Present Illness and Local Condition.—The patient entered the hospital in May, 1921, suffering from cramp-like pains in the left calf muscles, followed by pains in the toes of the left foot. The onset occurred five months previously, when a small spot of ulceration was noted on the dorsal surface of the small toe of the left foot. This ulceration developed into a deep slough, from which a purulent discharge was noted. Arterial pulsation was not present at either ankle or foot.

Operation.—Decortication of the left superficial femoral artery was performed a month after admission. *Result:* Several weeks after the operation the gangrenous ulcerated area healed into a very hard, resistant scar, and this area has remained healthy for over a year. *Marked improvement.*

Case II (Group 2).—N. F., male, age sixty-seven. *Complaint:* Severe pain in the left leg.

Present Illness and Local Condition.—Two years ago patient noticed weakness in both legs, followed by intermittent, cramp-like pains on exercise, the pains extending from the foot into the thigh. In the last four months the pain was so severe as to render walking impossible. The left leg became violently hyperæmic, swollen and painful, especially in the dependent position. No arterial pulsations could be made out in either leg or below the bifurcation of the aorta. There was marked tenderness about the left knee, foot and ankle.

Operation.—Decortication of the left superficial femoral artery. *Result:* No improvement followed the operation and death occurred from ascending gangrene of the operated extremity. *No improvement.*

Case III (Group 2).—A. C., male, age thirty-six. *Complaint:* Gangrene of the left index finger.

Present Illness and Local Condition.—From 1917 to 1921, the patient suffered with lupus erythematosus of the face, and during the period from 1919 to 1921, he had several attacks of circumscribed œdema in various portions of the body, affecting nose, eyelids, cheeks and legs. The legs were very œdematous at the time of admission into the hospital in March, 1922. Several months ago circulatory disturbances were noted in the fingers of the left hand, terminating in gangrene of the index finger with beginning trophic changes in the middle finger. The whole hand, and particularly the areas about the affected portions, was very tender, and pulsation in the left wrist could be made out with difficulty.

Operation and Result.—Decortication of the left brachial artery was followed by no change in the condition. *No improvement.*

Case I (Group 3).—C. C. K., male, age thirty-five. *Complaint:* Excruciating pain over the palmar surface of the right thumb and base of the index finger.

Present Illness and Local Condition.—Patient suffered a slight bayonet wound in the elbow in 1918. Six months prior to admission to the hospital, in October,

1921, while working at the mechanic's trade, he gouged out a small segment of tissue from the radial aspect of the terminal phalanx of the right thumb, in which injury the knife cut to the bone. Although the wound healed four weeks later, there followed a constant burning pain in the area above mentioned, which was accentuated when the arm was in the dependent position. Two weeks later the scar tissue was removed, but there was no improvement in the pain. Examination showed an indented area on the thumb where the scar was removed, with this area and base of the index finger exquisitely tender to the slightest pressure. Arterial pulsation was normal. No definite diagnosis could be made other than a pain causalgic in character.

Operation.—Decortication of the right brachial artery was performed. *Result:* The pain in the finger was almost entirely relieved on the day following operation and disappeared entirely two weeks later. At this time, however, he developed pain and tenderness over the bodies of the flexor muscles of the right forearm, which pain disappeared after a period of several months. *Marked improvement.*

DISCUSSION OF THE RESULTS

In this series ten arterial decortications were performed on six patients, on one of whom three arteries were decorticated for disease of three extremities, while on another the operation was performed on two arteries for trouble in two extremities. We have made no clean-cut diagnoses in these patients, but have chosen to place them into three groups. In group 1, we have described those patients in whom the arterial changes at the time of operation were thought to be spasmodic in nature rather than obliterative, as evidenced by the presence of palpable, peripheral, arterial pulsation. In group 2 are mentioned those cases in whom an obliterative arteritis had seemed to play the predominant rôle, and where no arterial pulsation in the affected extremities was elicited. Group 3 is that of unaccounted-for pain, in which we have but one case.

In the first, or spastic group, Case I (E. H.) was operated upon with no beneficial result. In Case II (P. O.), no improvement can be recorded, since the violent skin discoloration and the sensation of cold in the diseased extremities have reappeared, and the ulcerations have returned. No improvement followed the operation in Case III (E. D.), in whom an amputation of several fingers had later to be resorted to.

In considering the second group of cases, in whose affected extremities no arterial pulsation could be elicited, one definite cure is reported, Case I (C. E.). Whereas for months this patient had an ulcerative gangrene of the dorsal surface of the middle toe of the left foot, several weeks following the operation the gangrene disappeared and the sloughing healed into a resistant scar, which has remained healthy over several months. In Case II (N. F.), no improvement followed the operation, and the patient later died from an ascending gangrene of the operated extremity. In Case III, no improvement followed the operation, and the gangrene remained as before intervention.

Case I, of group 3, was operated upon for an unaccounted-for pain in the thumb. Following the operation the pain disappeared, but for it was substituted another pain in the flexor group of muscles. This pain later likewise disappeared, and there has been no recurrence of the symptoms.

We wish to state here that we have operated upon no patients who exactly correspond in their diagnoses, or clinical pictures, to those treated so successfully by Doctor Leriche, and it would then appear illogical to pass hasty judgment on this operation from the results of the treatment of our series of cases.

There are, however, certain fundamental principles wherein we differ with Leriche. The conception of primary importance is the knowledge of the path of the vasomotor fibres to the extremities. One gains the conclusion, from careful study of his work, that he considers the majority, if not all, of the vasomotor fibres to the extremities follow the sheaths of, and lie in, the adventitia of the larger arteries. From what has been said concerning the path of these fibres, we see that anatomists and physiologists concur in the belief that they accompany and are embodied in the spinal nerves which run to these parts. If such be the case, the vasomotor sympathetic fibres must leave these spinal nerves at different levels in their course, and supply innervation to the arteries from point to point as this innervation is required. Hence, it is a gratuitous assumption, from the point of view of proven work, that these fibres run a course along the arteries, and that their continuity may be severed, irritated, or otherwise interfered with by a removal of a thin sheet of tissue about the sheath or adventitia. So far as physiologists can prove, the only sympathetic fibres which accompany the large arteries to their termination are those which run from the prevertebral ganglia to the thoracic and abdominal viscera. There now arises the natural question as to the proof that these sympathetic fibres are removed at the time of operation. Points of difficulty in the staining technic for the demonstration of these nerve fibres in the tissue thus removed from an artery, require that further work be done upon this subject. It is rather striking, also, that in our cases, save in one instance, we were unable to demonstrate any post-operative rise in blood-pressure, or increase in surface temperature.

We are, at this writing, forced to the conclusion that an insufficient number of observations of this operation has as yet been made. It is only by careful physiologic estimation of capillary,[71] surface temperature [3] and blood-pressure changes, that a correct conclusion is to be reached. In this discussion, however, we would not overlook the fact that great improvement in otherwise hopeless conditions, has resulted from this procedure, even though the mechanism of the production of the diseases and that of their cure is as yet unknown.

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PERI-ARTERIAL SYMPATHECTOMY

AN EXPERIMENTAL STUDY

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The treatment of a wide range of pathological conditions in the extremities by the removal of the sympathetic fibres situated in the wall of the artery supplying the part, was first suggested by Leriche in 1913.[1] In the years intervening up to the present time, he, his collaborators and others in France have contributed many papers on this subject. Most of these papers are clinical in nature, although mention of experimental work is made. The ideas represented by this school have not spread widely in other countries. In America, Halsted [21] alone reports a case that bears out Leriche's contentions. No conclusive experimental work has been reported. The present work was done in an attempt to prove a part of Leriche's contentions by an experimental study.

Leriche maintains that our knowledge of the peripheral sympathetic is inadequate. On the basis of numerous clinical observations he has built up a somewhat elaborate conception of the physiology of this portion of the autonomic system, a conception difficult to visualize because, as he frankly confesses, many elements are not clear even to himself. Briefly, his ideas may be summarized thus: (1) The sympathetic fibres distributed in the various tissues of an extremity are in a state of "balance" which maintains the normal functional conditions of blood-supply, secretion and so forth; (2) any "irritative" lesion in any part of this distribution—*i.e.*, the arterial wall, the nerve, the muscles, etc.—may result in a state of unbalance which will in turn result in circulatory, sensory or nutritional disturbances; (3) a complete break in the cycle of sympathetic influence together with removal of the "irritative" lesion will reëstablish the normal balance. It is only fair to state that this summary is my own attempt to compress into a small and easily grasped form a large volume of scattered inferences. It may not approximate Leriche's own summary, were he to attempt one; and it is open to almost as many exceptions as the observations it covers. On the basis of this theory he has proposed and carried out the stripping of the adventitia of the brachial or femoral artery (with the intention of removing with it the sympathetic plexus therein contained, and of thereby breaking the chain) in such conditions as causalgia, "troubles reflexes," œdema, trophic ulcers and the skin changes following venous varicosities. His cases of causalgia and circulatory disturbance were largely the result of war wounds, where partial lesions of artery or nerve could be demonstrated. His results have not all been successful; but there has been enough improvement in numbers of cases to justify his hope that a new method of treatment has been devised.

It is not my purpose to review in detail the mass of these papers nor to

attempt a critical analysis of his theory on the basis of his case reports. That task could be assumed only by one whose clinical experience in these obscure conditions was as wide as that of Leriche himself. In this connection I may quote a paragraph from Carter,[30] whose experience covers twenty-three cases of true causalgia among 3000 peripheral nerve injuries. "Leriche's and Tenani's operations, or denudation of the associated arteries and veins of their sympathetic fibres as already described, are of no value in true causalgia, although they may be in certain cases of peri-arterial sympathetic neuritis. Tinel, Veyrassat and Schlesinger reported favorably upon its use; but Girou says that the causalgia of Weir Mitchell is not curable by this method, although another type, exclusively sympathetic, yields to the denudation of the peri-arterial sympathetic."

Leriche's papers, which contain detailed case studies, record numerous instances of these conditions treated by his vascular stripping operation. His reports show the following physiological effects. At the moment of stripping the exposed artery it becomes markedly constricted in the zone of damage so that the peripheral pulse is much diminished or even vanishes. The immediate result, lasting for several hours, is a diminution of blood-pressure and a lowering in temperature of the extremity. The secondary effects, becoming evident after several hours, consist in increases in blood-pressure and pulse-pressure and a rise in local temperature of 2 to 3° C. These effects are at their maximum for a few days and gradually diminish, to disappear between the fifteenth and thirtieth days. Leriche considers the secondary effects to be due to the absence of the vasoconstrictor impulses delivered through an intact sympathetic. Parenthetically it may be remarked that this idea is untenable unless one is to believe that all the vasoconstrictor supply to a part is present in the vessel at a high level, *e.g.*, in Hunter's canal. This is a difficult assumption to make in the face of our knowledge that certainly a large proportion of the autonomic to the vessels of an extremity is delivered to the sensory-motor nerve near its origin and reaches the vessel at various points in its course. Kramer and Todd [4] have established the anatomy of this distribution for the arm and Potts [5] for the leg. The latter may be quoted as follows: "From the anatomical facts herein stated, it follows that local damage to a large artery will injure the vascular plexus at the point of damage only, but will not account for changes produced in the vessel at a distance from the injured site." Todd [2, 3] in studying the sympathetic effects in cases of cervical rib, expresses a like opinion. Whatever the theoretical basis may be, the possibility of testing out these physiological effects under experimental conditions was presented, and the attempt to do so forms the first section of this study.

An element of predominant practical importance was also presented. From the standpoint of common experience, by far the most important of the conditions cited are, of course, the chronic ulcers of so-called trophic or other etiology. If it were possible to accomplish healing of these ulcers by this relatively simple operation, a great addition would be gained to our resources

in a large and intractable group of cases. It seemed important therefore, as it had seemed indeed to Leriche, to establish the effect of sympathectomy on wound-healing. He mentions [29] an experiment on a rabbit in which the healing of wounds of the ear was studied after division of the cervical sympathetic. This procedure, of course, results in removal of the vasoconstrictor fibres and a hyperæmic ear. His experiment showed a distinct acceleration in the healing of a wound in the sympathectomized ear, together with marked differences in appearance between this wound and that in the control ear. In view of the practical importance of this particular point, a repetition of this experimental approach to the subject was also made.

The first group of experiments, then, consisted in the study of the circulatory effects in an extremity of Leriche's operation. Inasmuch as these effects are the result of changes in vasomotor tone, it was felt that temperature measurements would be a reliable index to the occurrence of the effects expected. No attempt is made to assume any absolute quantitative value for the measurements. Dogs were used and the femoral artery chosen for the operation. It required a considerable number of operative experiences before the stripping of the vessel could be done without tearing the musculature; and even thereafter, as will appear, there were failures. Observations of leg temperature were made either by training the dog to stand in an especially constructed calorimeter for twenty minutes or by inserting thermometers symmetrically in the two legs under aseptic precautions.

Experiment I.—Dog, male. Chosen for gentleness and tractability. Trained to stand with feet in calorimeters for twenty minutes at a time. Control readings of leg temperatures. July 11.—Right leg 0.1°C. warmer than left. July 13.—Legs same temperature. July 14.—Legs same temperature. July 15.—Nine A.M. Ether anæsthesia. Right femoral artery stripped. No constriction of vessel observed. Left femoral artery dissected out but not stripped. Both wounds closed with silk.

Readings. July 15.—Four P.M. Legs equal in temperature. July 16.—Wounds clean. Left 0.1°C. warmer than right. July 18.—Left 0.1°C. warmer than right. July 18.—Three-thirty P.M. Both wounds clean. Right femoral artery exposed and a small film of tissue over part of circumference could be removed. No constriction observed. Wound closed as before.

Readings. July 19.—Nine A.M. Left leg 1.7°C. warmer than right. July 19.—Three-thirty P.M. Left leg 0.1°C. warmer than right. July 20.———Left leg 0.1°C. warmer than right. July 22.—Three P.M. Legs equal in temperature. July 22.—Four-twenty P.M. Ether anæsthesia. Right wound reopened. Marked inflammatory reaction but no pus. Artery resected from upper margin of stripping to a point 1 cm. below lower margin of stripping.

Readings. July 23.—Left leg 0.8°C. warmer than right.

Experiment II.—Dog, male. Calorimeter method. Less easily trained than dog in Experiment I. After considerable preliminary training the following control readings were obtained. August 1.—Left leg 1.1°C. warmer than right. August 18.—Left leg 0.8°C. warmer than right. August 19.—Left leg 1.7°C. warmer than right. November 10.—Left leg 0.4°C. warmer than right. November 14.—Left leg 1.0°C. warmer than right. November 16.—Ether anæsthesia. Right femoral artery stripped. No constriction of artery observed. Wound closed with silk. No wound made in left leg.

Readings. November 17.—Right leg 0.1°C. warmer than left. November 26.—Wound open, but clean. Legs equal in temperature. November 30.—Ether anæsthesia. Laparotomy, two cm. of right abdominal sympathetic resected.

Readings. December 2.—Right 1.7°C warmer than left. December 5.—Right 1.4°C. warmer than left. December 8.—Right 1.7°C. warmer than left.

Further experiments of the same sort were attempted, but in these instances the effort to strip the relatively small vessel completely resulted in such damage as to necessitate ligation of the vessel. This, of course, rendered the animal, highly trained and of a disposition not common among laboratory dogs, unfit for further experimentation. A large amount of time and effort were wasted in this way. For that reason, the more direct measurement of subcutaneous temperature by thermometers was adopted. Delicate thermopile records did not seem indicated, inasmuch as only marked differences in temperature would be of significance.

Experiment XXVI.—Dog, male. June 14.—Three-fifteen P.M. Ether anæsthesia. Thermometers placed in the subcutaneous tissue in symmetrical positions in each lower leg. Readings for fifteen minutes showed equal temperatures in the two legs within 0.1°C. Three-thirty P.M.—Both femoral arteries exposed. Right femoral stripped for 2 cm. of as much adventitia as could be obtained. No constriction observed. Both wounds closed. Readings for ten minutes after close of operation showed left leg 0.3°C. warmer than right. Thermometers out and small skin openings sutured.

June 15.—Wounds clean. One-fifty P.M.—Ether anæsthesia. Thermometers placed in untouched region about knee-joint in each leg. Readings showed approximately equal temperatures, the right leg 0.2°C. warmer than the left. Two P.M.—Laparotomy and excision of right abdominal sympathetic. Wound closed. Operation concluded at about two-thirty P.M. Readings for fifteen minutes showed right leg 1.5°C. warmer than left. Killed with ether. Post-mortem demonstrated removal of right abdominal sympathetic almost to diaphragm.

Experiment XXVIII A.—Dog, female. June 26.—Ether anæsthesia. Three-thirty P.M.—Thermometers placed as in Experiment XXVI. Readings showed equal temperatures in the two legs up to 3:45 P.M. Three-forty-five P.M.—Both femoral arteries exposed. Right artery stripped. No constriction noted. Both wounds closed. Operation finished at 4:05 P.M. Readings for fifteen minutes showed left leg 0.2°C. warmer than right.

June 27—Wounds clean. Two-fifty-five P.M. Ether anæsthesia. Thermometers placed in undamaged region about knee-joint. Readings for fifteen minutes showed left leg 0.1°C. warmer than right. Legs each about 2.0°C. warmer than on previous day. Three-ten P.M.—Laparotomy. Excision of right abdominal sympathetic. Considerable bleeding from branch of vena cava. Wound closed at 3:35 P.M. Readings for fifteen minutes thereafter showed right leg 1.8°C. warmer than left. Killed with ether. Post-mortem demonstrated removal of right abdominal sympathetic.

Several experiments were also done to check abdominal sympathectomy alone without the preliminary femoral stripping. This experiment is, of course, a classical one. It was performed rather to establish roughly the quantitative relationship under the experimental conditions of the present study than to demonstrate the presence of a vasodilation in the corresponding leg. The protocols of two of these experiments follow:

Experiment XXV.—June 13.—Dog, male. Ether anæsthesia. Thermometers placed symmetrically in subcutaneous tissue of inner surface of each lower leg. At start of experiment right leg was 1.0°C. cooler than left. Laparotomy and resection of right abdominal sympathetic as high as about the mid-dorsal region. Readings on the legs for twenty-five minutes thereafter showed right leg from 0.8°C. to 1.0°C. warmer than the left, a net gain of about 2.0°C. Killed with ether. Post-mortem demonstrated removal of sympathetic.

Experiment XXX.—Dog, female. July 13.—Ether anæsthesia. Thermometers placed symmetrically in subcutaneous tissue of lower legs. At start of experiment right leg was 0.4°C. to 0.5°C. warmer than left. Right abdominal sympathetic removed to diaphragm. Fifteen minutes later, difference in temperatures of two legs was unchanged.

July 14.—Ether anæsthesia. Wounds clean. Thermometers placed symmetrically near region of knee-joints. After fifteen minutes observation a difference was obtained which remained constant for fifteen minutes longer. Right leg 1.8°C. warmer than left, a net gain of about 1.5°C. (This animal was then used for the study of healing of wounds as described later).

In the study of these protocols two facts stand out. (1) It is impossible to reproduce experimentally on dogs the circulatory changes described for human beings following the stripping of the adventitia from the main artery to a part. (2) These changes occur in the dog's leg following demonstrable removal of the vasoconstrictor fibres to the part. These results added to the anatomical consideration already discussed, make it seem highly improbable that Leriche's secondary effects are actually due to the removal of vasoconstrictor fibres. What they may be due to, it is difficult to surmise. Certainly he does not mention the possibility that the mere operative wound might increase local temperature on the affected side. We are all familiar subjectively with the local heat of a finger suffering from an extensive laceration even when it is healing kindly. If it be infected, we observe a much more marked increase in temperature. The following experiment was therefore performed:

Experiment XXXV.—August 7.—Dog, female. Ether anæsthesia. Three P.M.—Thermometers introduced subcutaneously in right and left legs, Symmetrical positions.

Readings	Right	Left
3:05 P.M.	36.2°C.	36.1°C.
3:10 P.M.	36.2°C.	36.2°C.

Three-fifteen P.M.—Right femoral artery dissected free. Not stripped. Wound closed with silk. Large branch of femoral vein accidentally torn and ligated.

Reading	Right	Left
3:25 P.M.	36.1°C.	36.2°C.

August 8.—Wounds clean. Ether anæsthesia. Two-fifty-five P.M.—Thermometers introduced subcutaneously in right and left legs. New symmetrical positions.

Readings	Right	Left
3:00 P.M.	36.8°C.	35.8°C.
3:05 P.M.	36.9°C.	36.0°C.
3:10 P.M.	36.7°C.	35.8°C.

Here we see an increase of almost a degree in the temperature of the leg that underwent a simple dissecting operation over that of the unoperated leg. It is to be noted also in Experiment II, that the operated side after stripping of the vessel showed a gain of a fraction of a degree over the unoperated side. This gain was increased by a full degree or more when the abdominal sympathetic on that side was removed. In this experiment no wound was made on the control leg. The gain in the operated leg in the first step of the experiment approximates that in the experiment just quoted. Although these results are by no means conclusive, they suggest a partial cause for findings of Leriche.

In the second group of experiments the sympathetic in the neck of a rabbit was divided and at the same time wounds of equal size were made in symmetrical position on the two ears. These were marked out with a cork-borer, in order to be certain of equal size, and the skin alone was stripped off. The following day observations were made of the presence or absence of the sympathectomy syndrome—namely, the contracted pupil, advanced nictitating membrane and hyperæmic ear. The progress of healing of the wounds was followed from day to day. In a few instances the vagus was divided in the search for the minute sympathetic. These experiments are recorded in those instances in which the syndrome of sympathectomy was present. Four experiments with wounds on the ears of dogs and one with wounds on the leg are also included. Typical protocols for experiments on both dog and rabbit follow.

Experiment XXI.—Rabbit—Ether anæsthesia. June 7.—Right cervical sympathetic dissected from vagus and divided. Wound 1 cm. in diameter made with cork-border in corresponding positions on dorsum of each ear. June 8.—Evident vasodilation, right ear. Right pupil smaller than left. Nictitating membrane further advanced on right than left. Wounds dry and clean. June 10.—Wounds clean. Equal size. June 12.—Wounds equal in size. June 14.—Wounds equal in size. June 15.—Right wound slightly smaller than left. June 16.—Contraction well under way. Right still slightly smaller than left. June 17.—Approximately equal in size. June 18.—Wounds about 2 mm. in diameter on each side. June 19.—Both wounds healed.

Experiment III.—Dog, male. July 20.—Ether anæsthesia. Division of left cervical sympathetic. Thoracic duct injured. Wound 1 cm. in diameter made in corresponding positions on dorsum of each ear. July 22.—Nictitating membrane advanced one-third across left globe. Left pupil much smaller than right. July 25.—Neck wound discharging. Probably a lymphatic fistula. Ear wounds clean. Left somewhat smaller than right. July 28.—Left ear wound slightly smaller than right. August 1—Contraction rapid. Left wound still slightly ahead of right. Neck wound healing. August 3.—Right, 2 mm. in diameter. Left, healed.

Of experiments that showed the typical syndrome for cervical sympathectomy, four were done on the dog and thirteen on the rabbit. The results are summarized in the following table. These wounds required about two weeks for healing. In no case was there a difference in favor of the hyperæmic side of more than forty-eight hours in healing time. In two instances there was a difference of several days in favor of the control side, but this

could be explained by incidental damage such as from too free use of the depilatory solution in preparing for operation.

Table I.—Animal	(1)	(2)	(3)	(4)
Dog	1	1	0	2
Rabbit	1	3	7	2

Column (1)—Experimental wound healed by forty-eight to twenty-four hours more rapidly than control wound. Column (2)—Experimental wound healed twenty-four hours or less earlier than control wound. Column (3)—Both wounds healed on same day. Column (4)—Control wound healed twenty-four hours or more sooner than experimental wound.

The single experiment on the leg of the dog was performed on the animal used in Experiment XXX. This dog had had an abdominal sympathectomy on the right side with a proved increase in temperature of the right leg of 1.5°C.

Experiment XXX (continued).—July 14.—Thermometric readings of temperature of legs as noted in first protocol of Experiment XXX. Wounds of equal size about 1.5 cm. x 0.5 cm. made in uninjured portions of each leg in corresponding sites. July 24.—Abdominal wound and subcutaneous wounds for thermometers healed cleanly. Experimental and control wounds clean and equal in size. Measure 0.4 cm. by 0.2 cm. July 26.—Both wounds healed.

In none of the entire series of experimental and control wounds was there observed any constant difference in the appearance of the two wounds. The granulations were not more hyperæmic in the wound on the sympathectomized ear. Furthermore, the period of contraction of the two wounds coincided in almost all instances as the table indicates.

These experiments do not successfully repeat those mentioned by Leriche. They must be interpreted as being quite negative in showing any effect on wound healing of a vasodilation consequent to the removal of the sympathetic supplying the region of the wound.

CONCLUSIONS

(1) "Perivascular sympathectomy" of Leriche does not result experimentally in the dog in the physiological changes in the extremity described by him in clinical cases.

(2) Vasodilation resulting from proved total sympathectomy does not affect wound healing.

Note.—Following the completion of the first group of experiments here reported, I encountered an incidental reference to experimental work by Leriche.[2a] No further description of these experiments was found. He says: "Experimentally I have not obtained any results of interest. The large vessels of the dog do not contract after stripping."

In addition, through the courtesy of personal communications from Dr. David C. Straus and Dr. A. E. Halstead, I am informed that three perivascular sympathectomies have been performed by these surgeons in clinical cases. Doctor Straus in speaking of his two cases adds "Both cases showed Leriche's 'physiological effects.'" These cases were reported before the Chicago Surgical Society, November 3, 1922.

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ALUMINUM-POTASSIUM NITRATE IN THE TREATMENT OF SUPPURATIVE CONDITIONS, PARTICULARLY OSTEOMYELITIS

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The World War brought forward many advances in the treatment of infectious processes, both from the viewpoint of improved surgical technic, and also the pre- and post-operative treatment by means of improved antisepsis, greatly facilitating the surgeon's work, and in many cases rendering surgical intervention unnecessary.

All of the accepted methods, however, included the use of an antiseptic or germicidal agent, chief of which were the iodine and chlorine derivatives, the earlier simpler mercurials and phenols having been practically discarded. Many highly organized organic compounds, such as diaminomethyl acridinium and its chlorides (acriflavine) have been investigated and proposed in the effort to reach the desideratum—that of low toxicity and high germicidal index free from effects tending to delay or inhibit the natural regenerative processes.

The writer's experience in the management of infected cases closely parallels that of most surgeons with the comparatively small proportion of satisfactory results compared to those obtained in other fields of practice, and a considerable portion of time has been diverted to the observation and investigation of the cultural, non-antiseptic, aluminum-potassium nitrate method. A preliminary report upon which is herewith presented.

In the selection of a definite line of investigation, we are at once confronted by two diverging paths—one leading along the well-beaten track of antisepsis including the employment of a germicide specific to the organism known to be present—the other pointing to the "antibody" method by which natural processes within the body tend to eliminate the invading or infecting organism. This latter path was followed, paralleling in many ways that of vaccine and serum therapy, *with the one striking difference that the "antibody" is developed in the original host instead of being transplanted and evolved in an animal.*

The aluminum-potassium nitrate compound method of treatment is the direct development of observation of the meat preserving industry where the so-called "brine" containing potassium nitrate is employed as the oxidizing agent. A number of cases were treated with successful end results, using potassium nitrate alone, but it was found to produce great irritation and sloughing of tissues, together with maceration of surrounding normal tissues, all of which rendered its use alone almost prohibitive. The potassium nitrate action seemed to be cumulative, reaching the maximum in about ten to fourteen days, with its attendant irritation. Reduction of the dosage, while

decreasing the irritation, also reduced the reaction to such a degree as to be of little value. It became evident at this point that some modifying agent must be added which would admit of maximum reaction with a minimum of irritation. Many combinations, covering a great variety of salts, were tested out, and it was found that aluminum nitrate, astringent and non-irritant itself, seemed to have the property of inhibiting the pain, yet not interfering with the oxidizing properties of the potassium salt when combined in a dressing of low aqueous content, but had the drawback of falling apart in aqueous solution, again permitting the potassium element to exercise its irritant and macerative properties. Research was continued in the direction of finding a non-aqueous solvent to obviate this condition, and at the same time other experiments were carried on with a view of introducing a third element to stabilize the combination of the other two. Finally a compound was prepared by crystallizing aluminum nitrate and potassium nitrate from concentrated nitric acid which does not cause hydrolysis of the aluminum nitrate. The quantity of aluminum nitrate and potassium nitrate used should be in the proportion of the molecular weight of one molecule of aluminum nitrate to three times the molecular weight of one molecule of potassium nitrate. For example, 375 grains of aluminum nitrate and 303 grains of potassium nitrate in sufficient hot concentrated nitric acid to dissolve the substance will produce a solution from which the double salt $Al(NO_3)_3$ $3KNO_3$ $10H_2O$ will crystallize out on cooling and after drying the product it contains approximately 31 per cent. aluminum nitrate, 44 per cent. potassium nitrate and 25 per cent. water of crystallization. About 500 c.c. of concentrated nitric acid, kept hot by means of the water bath, is a suitable quantity of acid in which to dissolve one kilo of aluminum nitrate and potassium nitrate mixed in the proportions previously indicated. The described salt crystallizes from the concentrated nitric acid solution in the form of colorless rhombic and monoclinic crystals. They are readily soluble in cold or warm water in substantially all proportions. They possess an astringent slightly metallic taste. This product is further diluted with nine parts of potassium nitrate and the resultant mixture is incorporated in the dressing used in the treatment.

BACTERIOLOGICAL EXPERIMENTS

The nature of the infection in individual cases was determined by culture and subsequent plating and the relative number of organisms determined by direct smear from the exudate of the lesion. In the greater number of cases a mixed infection was found, staphylococcus aureus predominating. In many of the foregoing a Gram positive organism was present of saprophytic type. A small percentage of cases showed a pure culture of short chain streptococcus. It is of interest to note that in none of the cases diagnosed clinically and radiographically as tuberculous osteomyelitis were tubercle bacilli found on examination of the excretion. Staphylococcus aureus or a sterile fluid was invariably present. Examination of the smears before and during treatment show a marked increase in the number of colonies progressing with the course of

treatment and only decreasing in number and finally totally disappearing in the terminal cycle of treatment.

In an endeavor to determine the germicidal index of the aluminum-potassium nitrate compound, many experiments were carried out with the final conclusion that instead of possessing antiseptic and germicidal powers, *it actually assists and intensifies the growth of bacteria when added to the culture media.*

A uniform suspension of bacteria well distributed through diluted bouillon when introduced into media containing various percentages of the aluminum-potassium nitrate compound solution, showed growths varying from two to five times those found in the untreated media. These results were found constant in a large number of laboratory experiments.

ANIMAL EXPERIMENTS

The toxicity or rather non-toxicity of the aluminum-potassium nitrate compound was tested first on guinea pigs, then on rabbits and finally on monkeys (Macacus Leoninus) by the intravenous, subcutaneous and oral routes. The results in all instances show that the aluminum-potassium nitrate compound is entirely non-toxic, irrespective of its method of administration. Two large monkeys weighing 42 and 45 pounds, respectively, were given single intravenous injections of 80 grains each, and later the same amounts introduced intra-abdominally and intra-muscularly without the least untoward effect. The same animals were at the same time fed two ounces each of the salt each feeding. No loss of weight or decrease in activity or function could be noted. The intravenous and subcutaneous doses in these experiments were over double the average amount used *externally* in the treatment of human patients.

CLINICAL MANIFESTATIONS UNDER TREATMENT

In chronic cases of osteomyelitis of many years' standing, with sinus formation, where there has been only a thin serous discharge, which under the microscope shows a few epithelial cells and an occasional leukocyte, there appears within twelve to twenty-four hours after application of the dressing, a marked purulent discharge containing innumerable polymorphonuclear leukocytes and tissue shreds, although no reaction is apparent on the skin. This indicates that in these twelve to twenty-four hours, some element from the dressing must have passed into the deeper tissues to produce this acute reaction calling forth an increased leukocytosis expressed in terms of the pus discharge.

Dialyzation through the skin may be further observed by inserting a tube into the sinus, sealing same to the surrounding skin and observing the volume and character of the discharge. After this observation, a dressing of aluminum-potassium nitrate compound is applied, and a comparative observation made, when it will be noted that there has been a tremendous increase

in the volume, and a great change in the character of the discharge, which now consists almost entirely of leukocytes and débris.

If the dressing is discontinued, the discharge will immediately subside, and within a few days will resume its original amount and character. This conversion of a thin serous fluid into a purulent discharge can be due only to an acute reaction within the tissues, producing a rapid autolysis and liquefaction of the diseased area. This liquefaction and autolysis is produced first by the influx of leukocytes and phagocytes, and second by the nascent oxygen acting on the diseased tissues without affecting the normal. The nascent oxygen is probably derived by the splitting of the nitrate ion in its passage through the skin into the deeper tissues. Nascent oxygen does not alter normal healthy tissue, but the infiltrated tissues which are contaminated with organisms are affected by the aluminum-potassium nitrate compound, accounting for the selective action of this compound in attacking only the diseased structures.

The vesicle and pustule formation is probably the result of stimulation of the latent bacteria into marked activity by the aluminum-potassium nitrate compound which has been proven experimentally to be an excellent culture medium. Some of these pustules seem to connect with the deeper tissues. Fine probes have been passed through the skin pustule into the bone cavity.

Clinically, we are not able to produce a reaction beyond the area of disease or the point of infiltration of the soft tissue. In the case of a small area of osteomyelitis in the middle third of the femur, with an infiltration of the adjacent soft tissues, a dressing applied over the entire length of the femur will not produce a typical reaction in the skin, and no vesicles or pustules will appear beyond the affected or infected areas. The aluminum-potassium nitrate compound is apparently selective in its action because it produces no reaction where no organisms are present. This reaction apparently definitely outlines the area of infection. The vesicles and pustules show culturally in practically every instance the same organisms that are isolated from the deeper tissues.

In every case a hyperplasia of blood-vessels in the treated area is noted, evidenced both by the active hyperemia, and also from the histologic study of sections of deep tissues taken at the time of operation, many of which were done for the removal of large sequestræ.

Another observation of importance is the increasing bacterial count of the exudate during the initial period of treatment due to the application of a cultural dressing tending to stimulate the dormant bacteria of a chronic state into activity, reducing their virility and vitality in proportion to the increased rate of propagation, and at the same time increasing the resistant elements of nature by a local leukocytosis and phagocytosis in much the same way that natural forces deal with an acute infection.

In almost every case a marked improvement in the general physical condition of the patient is noted almost at once, making it seem that the aluminum-potassium nitrate compound was absorbed and had produced a direct systemic effect. Extensive investigation has not been able to support this theory, and

on the other hand, investigations by Professor Kahlenberg of Wisconsin University, failed to disclose any traces of either base in the blood or urine. Continuous observation of this effect, together with the constancy of the condition leads me to believe that the systemic reaction is more apparent than real, and is the result of a rapid autolysis producing local exudation at the site of the lesion where prior to institution of this treatment absorption had obtained, carrying the toxins through the system and imposing an abnormal load on the organs of elimination. The aluminum-potassium nitrate compound treatment simply maintained the case within localized limits permitting the eliminatory organs to resume their normal full functions without this excess load.

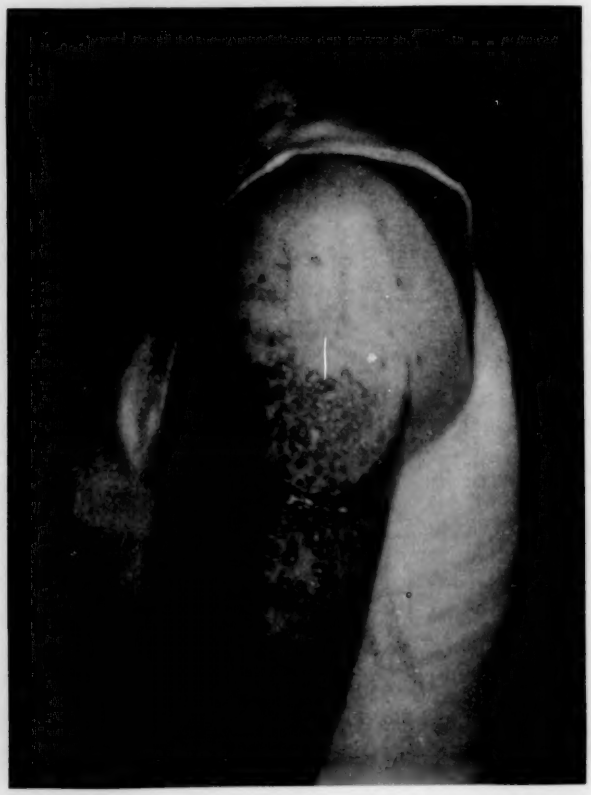

FIG. 1.—Cutaneous reaction in aluminum-potassium nitrate therapy.

TECHNIC

The technic of application consists in applying a plastic dressing directly to the affected area, made up of a vehicle into which the aluminum-potassium nitrate compound is incorporated. Ordinary rolled oats has been used for this purpose, and it has been suggested that same be sterilized for two hours in an autoclave, under about fifteen pounds pressure, for the purpose of destroying the proteolytic enzymes, which would otherwise tend to invert or sour it, besides introducing various other bacilli, tending to complicate the microscopic picture. Should an autoclave not be available it is suggested that practical sterilization of the rolled oats can be accomplished by heating for twenty to thirty minutes in an ordinary oven. Rolled oats is suggested as meeting the best average of the ideal requirements of availability, cost, cellular structure and, above all, being physiologically inert, thereby eliminating the irritant properties of many other available materials. The vehicle is made by adding approximately 50 c.c. of boiling water to the ounce of dry rolled oats, and stirring until a uniform mass is produced, after which

the aluminum-potassium nitrate compound is added and thoroughly mixed through. Experience has shown that the average dose is approximately thirteen grains of the aluminum-potassium nitrate compound per ounce of dry rolled oats. The dressing is applied about one-eighth of an inch thick directly to the skin well beyond the limits of the affected area, and is covered over with some waterproofing material such as wax paper, gutta percha, etc., in order to retain the moisture. This is an important procedure, which, if omitted causes the dressing to solidify and to become hard and shrink away from skin contact. This dressing should remain in absolute contact with the skin continuously and be changed *as often as it becomes saturated with the exudate,* and in any case should be changed at least once in thirty-six hours, on account of loss of moisture to tissues. No gauze should be interposed between dressing and skin.

FIG. 2.—Cutaneous reaction in aluminum-potassium nitrate therapy.

The definite dosage for individual conditions cannot be accurately plotted, as the individual peripheral nerve sensitivity largely governs the limit of nitrate content, excesses expressing themselves by burning sensations. The safe and rational clinical procedure would be to start with a relatively small dose and gradually increase it to the point where irritation appears, and then reduce it slightly below that point. This amount may be as low as five grains per ounce and may run as high as forty grains per ounce, varying with individual sensitivity and also with the part of the body treated.

It is of interest to note that an aqueous solution of aluminum-potassium nitrate compound applied in a non-plastic vehicle, such as a gauze pack, does not produce any of the typical reactions or effects of the above described procedure, but on the contrary induces a cessation of all reactions and promotes a rapid epithelization of the abraded surfaces resulting no doubt from imperfect skin contact retarding dialyzation.

Reaction.—The typical reaction manifests itself within about forty-eight hours with the appearance of an erythema very much like that of an erysipelas, and this is followed within a few days by vesicles and pustules over the affected area (see Figs. 1 and 2) containing purulent fluid, many of which continue to discharge after rupture, presenting the umbilicated appearance of a small-pox lesion without the crater and bluish edge. This definite reaction continues as long as the infection in the underlying tissues persists. The dressings become saturated with exudate, which renders them ineffective, at which time they must be renewed. A good practice is to change the dressings at least once in twenty-four hours.

The area of reaction during the course of treatment gradually reduces in size even though the original area is still being treated. This is perhaps an indication that the area beyond is free from the infecting organisms. This unusual and peculiar reaction in the case of chronic infections, both of soft tissue and bone, seems to be due to the passage through the skin and into the deeper tissues of some of the elements of the aluminum-potassium nitrate compound.

Indications.—In the course of several hundred cases treated successfully by this method, over one-half were of the mixed infection type with staphylococcus aureus predominating. One-third of all the cases cultured staphylococcus aureus alone, and the balance including streptococcus, pyocyaneus and saphrophytes. The lesions treated included osteomyelitis, both traumatic and hæmatogenic, bone tuberculosis where secondary infection was established, furunculosis, various post-operative wound infections, and some forms of gangrene.

This method of treatment was found to be contraindicated in the presence of malignancies because of the greatly increased local vascularity which seems to accelerate their growth.

CASE REPORTS

Tuberculosis of the Spine.—Male, twenty-four years of age, Polish. Admitted to the hospital August 10, 1922, with a diagnosis and typical manifestations of acute appendicitis (pain at McBurney's point 15,000 leukocytes, high temperature, tenderness, etc., in right lower abdominal quadrant). Appendectomy; usual technic, Battle-Kammerer incision. Appendix found inflamed, thickened, not containing pus.

Operation did not afford relief, patient continuing to complain of vague pains, heightened temperature and general malaise. X-ray examination of kidney and ureter as well as of hepatic region proved negative.

Aluminum-potassium nitrate compound was then applied over the entire right side. Within four hours a definite area of fluctuation was manifest, which ruptured spontaneously the following day, discharging thick pus, which yielded in culture an almost pure strain of staphylococcus aureus. The area of reaction extended to the lower dorsal spine and a stereoscopic radiogram, made at this time, disclosed a beginning tuberculosis of the first lumbar vertebra.

In this instance the aluminum-potassium nitrate treatment not only afforded excellent relief from pain by instituting prompt local drainage, but, which is more important, pointed the way to an obscure and unsuspected lesion. The treatment

was continued for four weeks more, when the patient left the hospital very much improved. He presented himself a month later for examination. The improvement in his condition progressed very favorably, and the patient returned to his usual vocation of a rather strenuous type within a month after the aluminum-potassium nitrate treatment was started.

Osteomyelitis of the Humerus.—Male, thirty-four years of age, American. Observation began April 14, 1922. At that time, the left arm was found very much swollen, painful to touch and motion, both active and passive, and a marked contracture at the elbow. Wassermann negative. Physical examination disclosed nothing of importance, other than the condition of the affected extremity. Radiogram showed an active infectious process, affecting over one-half of the length of the entire humerus, with considerable destruction and evidences of early operative intervention (curettements?). The surrounding soft structures were hard and infiltrated; no fluctuation; scars resulting from previous operative procedures red and angry looking.

Treatment with aluminum-potassium nitrate compound was commenced, changing the dressings every twenty-four hours. After the initial application, a marked softening was discovered overlying the affected area, surrounded with a general hyperæmic blush of the contiguous surface. During the succeeding forty-eight hours, many pustules appeared, discharging pus. At this time, the pain had entirely disappeared from the affected limb; contracture of the joint considerably lessened. After seven days of treatment a remarkable regression of the affected process was apparent, the arm being at this time about normal in size, with full return of function at the elbow. Pustules along the margin of the old scar continued to discharge a small quantity of pus, while those in the areas beyond disappeared under the same dressings.

Patient returned to his work, continuing the daily dressing. About three weeks later he returned, at which time no further reaction could be produced. No definite sinus developed in this case, drainage has evidently been accomplished by capillary absorption. Six months later an examination of the patient discloses him to be in perfect health, the arm to all appearances normal. There is no return of the symptoms and clinically at least the patient is to be considered cured.

Osteomyelitis of the Tibia.—Female, single, twenty-four years of age, American. Anamnesis discloses nothing of importance as far as family history is concerned. Patient states that she observed about three years ago, sharp intermittent pains in the right knee, which pains after a few weeks became continuous. Diagnosed by family physician as rheumatism and treated as such for a month. This was followed by an abscess below the knee, which the attendant opened and irrigated. Pain did not subside and fixation in plaster case was resorted to. Two months later the case was removed, but incision had not healed. Wide curettement of the tibia was then done, followed by three more similar operations at three-month intervals. Wound has remained open over three years with much destruction of the upper third of the tibia. Physical examination disclosed a rather poorly nourished individual. Urinary findings showed much indican and a slight trace of albumin. Wassermann negative.

The affected limb was subjected to the aluminum-potassium nitrate treatment for ninety days, applications were made daily, after which time the patient was discharged with sinuses healed. Two months later the patient presented herself for examination. No recurrence of objective manifestations can be noticed and subjectively the patient feels well. Patient gained in weight, is in better spirits and looks upon life with greater cheer. Radiogram made at the last examination shows prolific regeneration of the tibial defect.

Post-operative Suppuration in Abdominal Wall.—Female, fifty years of age, Austrian, came under observation with suppurative sinuses in abdominal cavity following laparotomy.

Usual treatment instituted by attending physicians without results. Attempts to heal the sinuses by the usual methods proved unsuccessful.

Aluminum-potassium nitrate treatment instituted. The day following the first application the drainage tubes which were left *in situ* were removed. The volume of discharge increased many times, necessitating changing of dressings every four hours. Six days after the beginning of treatment the upper sinus had healed by granulation and three weeks after treatment began the patient was discharged with both sinuses completely healed.

Osteomyelitis of the Femur.—Male, thirty-four years of age, Hungarian, presents himself with all classical manifestations of osteomyelitis.

The history reveals a condition that had been persistent for sixteen years, during which time at least eight or nine curettements had been done, and more than a couple of dozen incisions for relief of abscesses, which had burrowed in various directions. During the past five years the affected limb was never free for one month without discharging pus in some place. Amputation was seriously considered by his attendant; Wassermann negative.

Physical examination disclosed nothing of importance, other than objective and subjective findings of the affected limb. X-ray shows extensive destruction of the lower third of the femur, without tendency to regeneration. There is apparent absence of periosteum from the epiphysis to about the middle of the femur.

Aluminum-potassium nitrate treatment was instituted. Within a few hours after the first application the drainage became so profuse that dressings had to be changed every three or four hours. Five days later several small spiculæ of bone worked their way to the surface and they were lifted out with tissue forceps. At this time the dressings were changed thrice daily. Three weeks after treatment was instituted dressings were changed only once a day. The discharge at this time was markedly serous in character.

X-ray studies made a month after treatment was commenced showed a comparatively clear outline of the femur with beginning osteogenesis at the edges of the defect. The patient was able to note a complete closure of the sinuses, a disappearance of objective and subjective manifestations, three months and four days after treatment was commenced. A subsequent examination, two months later, shows no symptoms that might indicate any recurrence. These findings checked up with X-ray studies disclose progressive new bone formation.

Osteomyelitis of the Radius.—Female, nineteen years of age, American, presents forearm disclosing suppurative sinuses, the result of an open operation for Lane plating for fracture of the radius, the result of a fall. Plate had been removed some time after the operative area disclosed signs of infection. A plaster-of-Paris cast had been applied and antiseptic dressings were made through a large window cut in the plaster-of-Paris. A radiogram shows good apposition of fractured fragments, and a small quantity of spongy callus feebly attempting repair.

Aluminum-potassium nitrate treatment was started and continued daily for thirty-four days, at the end of which time the sinus was found healed. With the exception of a week at the hospital the rest of the treatment was strictly ambulatory. Two months later the X-ray examination disclosed new-formed callus welding the broken fragments. Patient has full use of the arm.

Osteomyelitis of the Foot.—Male, fifty-eight years of age, Bavarian. History discloses that patient had suffered from diabetes mellitus, for which he remained under his physician's strict care.

Physical examination disclosed a fairly well-nourished individual. Wassermann negative. Urinalysis with reference to sugar and albumin negative. His left foot disclosed that two toes had been amputated. A suppurative sinus at the distal end of scar tissue resulting from the amputation which exudes a thin, watery serum. Foot is very much enlarged. Cutaneous circulation poor, foot livid in appearance, suspected of beginning of gangrene.

Radiograph shows absence of the fifth metatarsal and about half of the fourth, the distal end of which seems to be sloughing. Surgical removal of the remaining fragment of the fourth metatarsal bone was performed. Œdema did not subside and the aluminum-potassium nitrate treatment was begun. Four days after the commencement of treatment the swelling had receded over one-third of the area affected and within the period of a week it had entirely disappeared. Two weeks later the sinus had healed and the patient was apparently cured, but remains still under observation.

CONCLUSIONS

That the treatment herein described is not in any degree a substitute for rational surgery, but must be considered as a pre-operative treatment in badly infected cases, enabling the surgeon to later work under more favorable conditions.

As a post-operative treatment in infected cases irrespective of whether the case was previously or subsequently infected.

As a procedure in those cases that have failed to respond to previous surgical measures and those patients who persistently decline operation.

Removal of sequestræ is in all cases advisable.

The aluminum-potassium nitrate compound is not an antiseptic, but, on the other hand, is a definite accelerator of bacterial growth, tending by rapid propagation to lower the vitality of the infecting organisms thereby assisting the normal resisting powers of the body to eliminate the invading organism.

Unlike most antiseptics, the aluminum-potassium nitrate compound does not attack normal tissues and does not interfere with granulation or the osteogenetic efforts of nature.

Pain, which in most cases, is the result of infiltration and consequent tension, is very quickly relieved, due to prompt autolysis and liquefaction relieving tension by absorptive elimination through sinus or systemic absorption.

Over 75 per cent. of our cases become ambulatory and are able to pursue their vocations, coming to the clinic for dressings in contrast to the radical surgical procedures of the past, thus eliminating long hospitalization and later invalidism with its attendant expense.

The method is relatively simple, may be used within wide limits, and employs a non-toxic medicament.

CHOLECYSTOSTOMY VERSUS CHOLECYSTECTOMY

By J. Christopher O'Day, M.D.
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The eternal fitness of things has ordained that all issues must be opposed before experience determines their actual values. As the advocates of an issue are the first to appear, and knowing, from the natural order of things, that opposition will be inevitable, it has become the conventional to create an impressive vehicle upon which the issue may be presented with dignity. Such vehicle has, usually, to do with either benevolence or altruism, and, where these may fail to fit with grace, the old *status quo* is pointed to as something very badly in need of improvement.

Prohibition, as set forth in the Eighteenth Amendment, is an example of what we have in mind, for there are good and honest men who are advocating it while other men men equally as good and honest are opposing it. We know, however, that in spite of the arguments of each, or whether or no we will have prohibition the United States will continue being a great nation.

Coming now to the question suggested by the title of this paper, namely, *Shall We Drain or Remove the Gall-bladder?* We are aware that one adopting either procedure would not entail the risk of becoming a professional Damocles, yet we do, and too often, forget that ardor will warp whatever may become exposed to it, even to one's best judgment.

If we were enabled to compare the end results of ten thousand cholecystectomies with the end results of as many gall-bladders drained we might then be able to have more definite reasons for our particular view of the question. By end results let it be understood that a record of each of the cases of the two sets be accurately kept, the record not to be complete till the subsequent death permitted a post-mortem examination of the biliary and pancreatic mechanisms.

Nothing short of such a tabulation could possess much scientific value, and not until more reliable and accurate methods of compiling data have been insisted upon can we justify the privilege of becoming impatient with those whose views happen to run counter to our own.

Since the splendid work of Robson in 1900, and that of Maurice Richardson a little later concerning the relation of gall-stones to chronic interstitial inflammation of the head of the pancreas, and then later to have the lesson driven home by post-mortem findings as well as observing at operations damaging sequelæ that were traceable to a previous removal of the gall-bladder, the belief has taken hold of us that the removal of a gall-bladder, even though it be filled with calculi and highly infected, imposes a risk on the patient that none of us would be willing to assume.

During the early days of this controversy many able surgeons declared themselves unwilling to depart from the many virtues the tests of time had

shown belonged to drainage. Drainage, they emphasized, is the surgeon's greatest ally. But conservatism, like truth and modesty, as goes the world, but seldom attracts, and its voice, like that of the one crying in the wilderness, is too often unheeded.

With gall-bladder disease two dangers are omnipresent—dilatation of the bile ducts and cirrhosis of the head of the pancreas.

Chronic interstitial involvement of the head of the pancreas is not the result of bile having been regurgitated into the ducts because of an obstruction to the papilla of Vater. It is made possible by the contiguity of gall-bladder, gall-ducts, duodenum and pancreas alone. Its origin is in the gall-bladder, a gall-bladder infected and containing stones, and it was Richardson who showed how this hypertrophic pancreatic cirrhosis is always turned back when the gall-bladder is drained.

While it is not clear how this infection reaches the pancreas by the contiguity of structure, and why its effect is limited to the head of the gland, yet, insomuch as it is brought to a favorable termination by drainage of the gall-bladder we can do no less than conclude that toward the pancreas is a direction of least resistance over which the infection or its products find an avenue of easy escape. When this direction of least resistance has been reversed by the introduction of a drainage tube, repair of the pancreas may begin and go on without further interference from the invader.

The work of Mann and Giordano shows that bile is not a factor in the so-called chemical pancreatitis, and while this fails to coincide with the work we reported in 1904, we still believe that pancreatitis will result more quickly from pancreatic obstruction than when the obstruction is in the funnel of the ampule of Vater.

One of our cases of acute pancreatitis was caused by a calculus obstructing the junction of the ducts of Wirsung and Santorini. Primarily the case was operated on for what was believed to be an acute perforated gastric ulcer. The areas of fat necrosis together with the enormously swollen pancreas changed the diagnosis. The stone was found on post-mortem.

If, as Mann and Giordano have shown, bile is no factor in the cause of pancreatitis, then we must conclude from our own observations, that obstruction to the papilla of Vater will, where the duct of Santorini does not open into the duodenum, produce pancreatitis. Not because of the regurgitated bile but because of the obstruction to the pancreas itself. Such an obstruction will not act so quickly as the one obstructing the pancreas alone, because the dilution with bile together with a means of escape through the liver renders the action of the pancreatic secretion less virulent.

But to return to the original question of removing or draining the gall-bladder one great deception has been recognized. The baneful effect of removing the gall-bladder may not begin to show itself till several years have passed following the operation.

It has been argued that conservation of the gall-bladder is unnecessary in the securing of adequate drainage, for the reason that a tube may be fastened into the cystic duct when the gall-bladder has been taken away. This argument is very weak. It is not a question of drainage alone, nor is it a question of saving the gall-bladder. It is much bigger than this, it extends way into the future health and comfort of the patient.

If the fate of the gall-bladder was the only thing there was at stake, and it was known for a certainty that the function of the gall-bladder was of minor importance and that one really could get along as well without as with it, then there would be no question to settle. But the fate of the gall-bladder, of itself, is begging the question, for the gall-bladder has a function and when that function is destroyed either by disease or removal the whole biliary system must pay the price. Often the pancreas is taxed.

We have been able to find no record of a case of cirrhosis of the head of the pancreas where the subsequent contracture of the connective tissue caused obstruction of the pancreatic duct. This cannot be said of the common duct. While, as Richardson pointed out, a severe degree of fibrosis does not obtain in the head of the pancreas when drainage of the gall-bladder has been the method of treatment, we must bear in mind that even though it should occur, the presence of the gall-bladder will save the life of the patient through a cholecystduodenostomy.

Occasionally the surgeon encounters what may best be termed the remnant of a gall-bladder. It has been obliterated by the ravage of infection. Its mucosa is gone and in its stead nothing but hard unyielding scar. It has the shriveled aspect which betrays the hopelessness of its state. There may still be one or more stones within the space that represents a part of the old lumen. It has been long since bile was admitted into it. When such a gall-bladder is met with we should first remember that such a remnant of a viscus gives rise to no symptoms, and should it have been pain complained of that led to the finding of such a gall-bladder its removal alone will fail the relief expected from the operation, a further search must be made. This is a case where disease has performed a cholecystectomy, and, were it possible to examine the biliary ducts at the time, the dilatation, which comes as a result of lost gall-bladder function, would be as distinct as when removed by the skill of the surgeon.

Unless it be plain that its function is irretrievably lost no gall-bladder should be removed, for it is well known and understood that the most desperate looking of them is restored to normal by drainage. We must permit ourselves to become impressed with the fact that when a gall-bladder has regained its function the biliary channels will likewise regain their normal tone and lumen.

The function of the gall-bladder is really composite. It has a chemical, physical and mechanical aspect, but as the art of the surgeon is a mechanical one, it is scarcely within the pale of his domain to discuss other than the mechanical function of the organs with which he comes to deal.

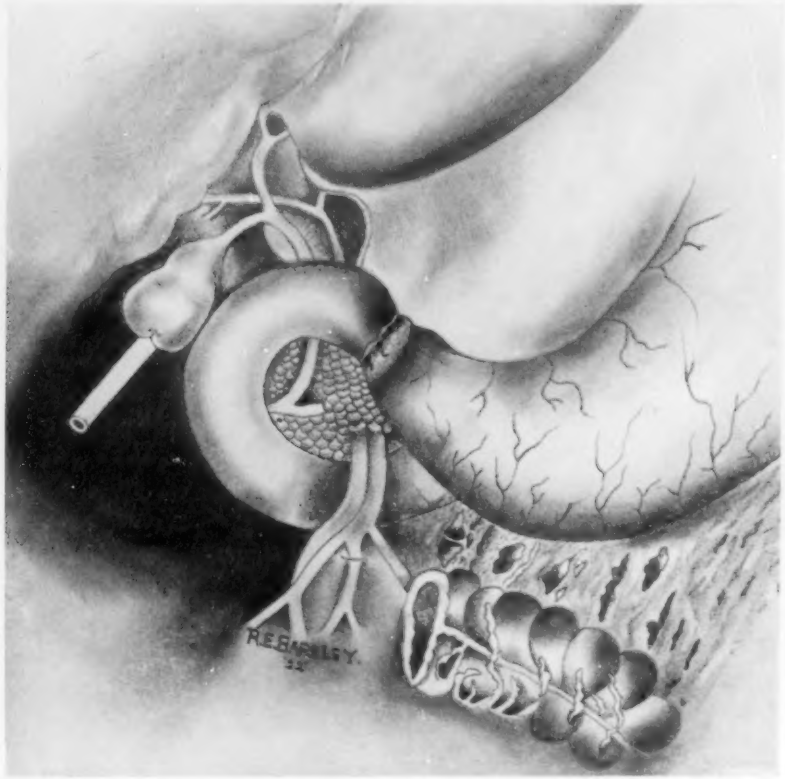

FIG. 1.—Note the difference in the size of the common duct above and where it pierces the pancreas and the narrowness of the conjoined opening of bile and pancreatic ducts. Conjecture the relief afforded by inserting the drainage tube into the gall-bladder. Note the manner in which the superior mesenteric vein and artery cross over the lower portion of the duodenum. A point in the anatomy, of uncertain importance, in certain types of ptosis. (Moynihan).

FIG. 2.—Showing the normal papilla of Vater within the duodenum. FIG. 3.—Showing how it is affected by cholecystectomy. The valve-like action is gone,—it is an unguarded opening into the liver.

We know that the dilatation of the bile ducts which comes as an afterclap to the removal of the gall-bladder is permanent. This alone should plead caution, because, once the valve-like action of the papilla has been rendered useless by such dilatation, ascension of infection will, by reason of the intra-abdominal pressure, sooner or later, give rise to a cholangeitis that is capable of assuming any degree of severity. In one of our cases calculi were found beaded throughout the upper common and the hepatic ducts.

The mechanical function of the gall-bladder involves the same principle that makes an air-chamber a necessary part of a high pressure pump. The very same principle which enables the water-ram to lift water above the level of its source. What the compressed atmospheric air within the pump's air-chamber means to the system of pipes receiving the discharge of the pump, and what suddenly arrested velocity means to the functioning of the water-ram, intra-abdominal pressure and the elasticity of the gall-bladder mean to the discharging of the bile from the liver.

Any system of pipes, no matter how strongly put together, will sustain leaks unless the pump furnishing the pressure be equipped with an air chamber. The compression and the decompression of such air acts as a cushion upon which the shock of each pump thrust is absorbed. If instead of the rigid pipes a system of pliant tubes be used, then without an air-chamber dilatation of the entire system would ensue and continue till a breaking point had been found. Excepting the breaking point, this is precisely what happens when the shock-absorbing function of the gall-bladder has been destroyed.

CHOLELITHIASIS, CHOLECYSTITIS AND CHOLANGITIS

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That the sequence of this subject be not broken, let us first briefly review the much written about question of (a) gall-stones and cholecystitis and then, the often much more important, allied (b) intra-hepatic conditions frequently concomitantly present.

Intra-hepatic Stones.—Considering the frequency of stones in the gall-bladder, one wonders that intra-hepatic stone formation is not much more common, than reported. (a) Being very small, intra-hepatic (bile-canal) stones are (probably aided by liver excursion) so easily washed downwards, via the ever enlarging bile-canals, to the still much larger ducts, that they are seldom encountered intra-hepatic at post-mortem examinations. (b) The greater distance from the infection within the intestines, the recency of secretion, and the almost continuous flow of bile make the formation of stones in the bile-canals less liable to occur. There are, however, many post-mortem descriptions in the literature of long, branched and cylindric intra-hepatic stones, with even extension downwards into the hepatic duct.

In the often quoted case of Chopart, the intra-hepatic stone-formation made it difficult to cut the " stony " liver at the autopsy.

Stones in the Ducts.—The conclusions are that: (a) Stones do not form in the ducts; (b) Hepatic duct stones are very probably always descending from the intra-hepatic bile-canals; (c) Cystic duct stones are usually from the gall-bladder, as are also usually common duct stones by " wandering " and failing to reach the intestine; (d) In rare cases cystic and common duct stones also, may be of intra-hepatic origin, must be conceded.

Gall-bladder Stones.—There are three possibilities: First, that very many small stones which have originated in the intra-hepatic canals, may descend into the gall-bladder and perhaps increase in size there. Second, that conditions present, may occasionally prepare the bile within the liver, for the formation of stones in the gall-bladder. Third, that gall-bladder stones are purely intra-cystic in origin, as a rule.

Gall-bladder stones occur as minute granules (gall-sand) alone, or as concretions of varying sizes, or as large stones only. The color varies, being alabaster-like, light or dark yellow, green, brown or black, gray or even white stones, according to contained pigment, chemical composition, or coating. The shapes were often green raspberrylike, especially if recent, spherical or oval if single; irregular, or facetted if multiple, due to pressure, friction, or other causes.

The number usually encountered by the writer was from one to thirty stones, varying in size from a millet-seed to small hen's egg. The writer has

removed over 2200, hundreds of others having been lost in the dressings from one case. The literature records cases with over 7000 stones.

A section of the liver in this case, removed at operation from just above the gall-bladder, proved microscopically to be carcinomatous. No intestinal malignant focus was discoverable.

The gall-bladders usually contained some slimy, often dark green or almost black bile; but bile with stones was occasionally almost or entirely absent, or a hydrops cystidis or an empyema of the gall-bladder was present.

The Composition of Gall-stones.—This is of the greatest interest, especially when considered with the causes predisposing and actual. (a) The most frequent gall-stone is of cholesterin and bile coloring matter, the alternating layers being lightly or more strongly stained with bile pigment. (b) Mixed stones, *i.e.*, a combination of the above with calcium carbonate, which usually formed a rough external coating, comes next in frequency. (c) Stones of entirely different chemical composition were often found together in the same gall-bladder.

Rare Stones.—(a) The pure translucent, alabaster-white cholesterine stone is very rare, they are usually very slightly colored with bile coloring matter. (The writer saw a pure translucent cholesterin stone the size of a pigeon's egg, removed from the gall-bladder by the late Doctor Mellish, late Surgery Instructor in Rush Medical College. It was whitish, very translucent, of very light weight, and had a very soapy feel. Recently an "almost" pure cholesterin stone the size of a large pea was shown me by Dr. E. Brougham of the Passavant Hospital.) (b) Pure pigment stones are described as dark green or black, homogeneous and very friable. The writer has never encountered one. (c) Pure calcium carbonate (chalk) stones are gray or white, hard, heavy, and usually rough. They are the most destructive and dangerous, and fortunately the most rare. (Both the pure calcium carbonate and the more common calcium carbonate coated cholesterin stone give an X-ray shadow.)

Predisposing Causes. Age.—Gall-stones are rare from infancy up to ten years. Three-fourths of one per cent. occur under twenty. The greatest frequency is after forty years of age.

Climate.—We have to consider the mode of life also, *e.g.*, in Norway 1 in 50, in Denmark 1 in 33, in Munich, Bavaria, 1 in 14 of all adults autopsied had stones in the gall-bladder. In the tropics where hepatic artery and portal vein liver (dysenteric, amœbic) abscesses are common, gall-stones are said to be rare.

External Pressure.—Corsets, kidney pads, belts, etc., by tightly pressing in the right hypochondrium, liver and gall-bladder, may kink the cystic duct and cause stagnation of bile. The "snared" liver from external pressure, so commonly reported in the European clinics as a cause of colic, was not encountered in a single case by the writer.

Intra-abdominal crowding due to tumor or pregnancy at-term are no doubt predisposing causes, but according to the writer's experience less

frequently so that the literature would lead us to suppose; yet it cannot be too much emphasized that gall-stones are common in women without and with tumors, with no family, small families, large families, in the lean and active, but more often in the inactive and fat, with shallow breathing, poor oxygenation and lessened liver excursion.

Ptoses Are Probably Quadruply Predisposing.—That a right floating kidney drags on the hepato-duodenal ligament, and not only kinks the ducts and causes (a) stagnation of bile, but is often also associated with wandering (Cantani's) liver, gastro-enteroptoses or general visceroptoses (Glenard), most common in multiparæ of spare habit, often resulting in (b) venous kinking and visceral engorgement, inviting (c) catarrhal gastro-enteritis, (Vater's) papillitis, with (d) possible ascending infection up the common duct.

Chronic circulatory cardiac and pulmonary disturbances such as mitral stenosis or regurgitation and also chronic pulmonary diseases are probable predisposing factors due to the venous engorgement. The lack of liver respiratory excursion especially in right-sided pleural or pulmonary disease is also a predisposing factor.

Habits of Eating and Living.—Hurried eating, irregular meals, overeating and drinking, poorly cooked or too sweet foods, sedentary habits, poor ventilation and hygiene, are adjuvant predisposing causes. The overtired, poorly fed, coffee and buttered toast feeding. Internes in poorly ventilated hospitals are especially prone to catarrhal jaundice, while sailors on ocean-going sailing vessels were considered particularly free from gall-stones by the older writers.

Certain acute and subacute infections, e.g., typhoid, or simple acute or subacute gastro-enteritis (the latter often almost symptomless) themselves or their sequelæ are predisposing.

A catarrhal inflammation of the duodenum no doubt always more or less involves Vater's papilla, and may ascend part way; or the whole length of the common duct (endoductitis communis); which with its inflammatory narrowing and increased *vis-a-fronte* to the gall-bladder "systole" and perhaps incomplete emptying of the same and stagnation of intra-cystic bile; may allow catarrhal infection to easily ascend (by continuity) up into the cystic duct (*endoductitis cysticus*) and thence to the mucosa of the gall-bladder itself (*endo-cholecystitis*).

Nomenclature should express in a word not only the site but the extent of an inflammation. The term cholecystitis alone is too inclusive and should be only used to express implication of the gall-bladder wall also, and peri-cholecystitis implication of the surrounding peritoneum.

Prophylaxis.—All glands whether salivary, mammary, biliary, pancreatic, renal, etc., resist ascending-continuity duct infections by the swift, free, downward flushing of their normal character and reaction gland secretion. The three important points then are (a) bile slowing, due chiefly to duct narrowing, (b) ascending infection, (c) excess of cholesterin present in bile under certain conditions.

(a) The normal gall-bladder systole and normal bile emptying protect the bladder and cystic and hepatic and common ducts, and thereby also the liver, from ascending cholangitis, and indeed the pancreas also; the duct of which latter occasionally opens a greater or less distance obove Vater's papilla into the communis choledochus. As the common duct however in most sedentary people is probably more or less always a harborer of bacteria, and narrowed; (b) the hypertrophied gall-bladder systole is very necessary indeed, to defend the cystic duct from the ascent of infection; for if the cystic duct once becomes infected the gall-bladder is certain to become so by aspiration, as the cystic duct is an affero-efferent duct.

(c) The real etiologic factor then in gall-stones formation, as well as in cholecystitis and cholangitis, is an ascending infection from the bowel to the gall-bladder, causing a precipitation of the bile salts, in which the larger quantity of cholesterin often present in the bile, probably plays an important rôle.

There are four possibilities as to behavior of gall-stones—First, if infection of the gall-bladder and ducts be not too severe, it can be recovered from before the precipitation of cholesterin, bile coloring matter or lime salts and the formation of gall-stones in the gall-bladder. The generally conceded idea that catarrhal icterus is followed by gall-bladder stone formation in every case, does not always hold good, because such an icterus may be due to infection and temporary complete atresia of the common duct only. If the cystic duct be still healthy the gall-bladder also remains healthy and no stones form. If, however, the infection reaches the affero-efferent cystic duct the gall-bladder will most certainly become infected and stones in all probability result.

Second: A "recovered" gall-bladder which to-day contains lots of bile and some mucus, and indeed some "duct passable" stones, is also probably capable of contracting, especially if hypertrophied, and emptying its slimy bile and nearly if not all of the stones, through the ducts, *i.e.,* if one can believe the histories of repeated typical colic attacks, in cases in which no stones were found at the operation, often to the consternation of both the diagnostician and surgeon, who too frequently place all of the operations-indication-importance on the finding of stones; and all too little on the often much more necessary drainage of the catarrhal gall-bladder and ducts, and possibly catarrhal intrahepatic bile canals; as will be explained later.

Third: The stones may remain and the gall-bladder and ducts so nearly recover after a severe gall-stone attack, that the patient may enjoy apparently normal health for years, often causing one for a time to question the diagnosis, and the stones be later an accidental discovery at celiotomy for some intercurrent disease or post-mortem; but as a rule after one attack, recurrent attacks occur sooner or later.

Fourth, the true relation of endo-cholecystitis without or with stones in the gall-bladder to possible hidden infection also of the intrahepatic bile canals (angiocholitis), should always be borne in mind.

Spontaneous Gall-stone Colic.—This deserves very careful description. (a) The violent contractions of a simple catarrhal hypertrophied gall-bladder

forcibly driving its viscid duct-distending bile alone through infected and infiltrated ducts may possibly cause some bladder or duct pain. (b) Very small smooth stones may cause much pain in their passage through non-distensile, infection-stenosed ducts, due to stone pressure on inflammatory-infiltration crowded nerve endings in the duct mucosa. Small gall-stones also undoubtedly often pass through healthy ducts with little or no pain.

The most violent pain is said to occur as the stone passes through Vater's papilla, which being nearest the intestine may at first be the most infected and infiltrated; but as it is also situated easiest for early recovery, in some cases it may be the place of the least pain. The most violent pain ever seen by the writer was from an impacted stone in the first part of the cystic duct.

Pain persisting for a time after the apparent passage of a stone was common, probably from duct wounding or inflammation or perhaps occasionally from the wandering of still another stone.

(c) The very first attack of colic may be from the sudden wandering and impaction of a single very large stone, especially in the first part of the cystic duct, causing a continuous excruciating pain, and indeed possible cystic duct rupture if not immediately operated upon.

CASE 6079. J. B., age forty-seven. Cholecystostomy by the writer at the Chicago Polyclinic Hospital, assisted by Dr. Louis Rudolph. This patient had always led an active, abstemious life. The only stone found was a smooth, flat, oval shaped cholesterin-pigment stone of Spanish nut size impacted in the first part of the cystic duct. Recovery was uneventful and permanent. Doctor Rudolph recently reminded me that the gall-bladder also contained much blood.

(d) Occasionally one encounters one single hen's egg or larger sized stone, filling the gall-bladder completely, which may have been enlarging there for years, that had, according to the patient's history, never caused any spontaneous pain whatever. A painless case of this kind occurred in the writer's surgical service in the Cook County Hospital, in a woman sixty-three years of age. The rough, calcium carbonate coated cholesterin stone was the size and shape of a small pear. Quite possibly this was a facetted pyramid of cholesterin-pigment stones united by a coating of calcium carbonate.

(e) Lastly, the very first attack of spontaneous gall-stone colic may be that of a peri-cholecystitis or true peritonitis from either a wandering through infection or thrombo-arteritis and necrosis, or perforating ulceration of the gall-bladder wall.

CASE 6081. Mrs. H., age thirty-two, taken with sudden violent pain at 6 P.M. Operation performed at 9 A.M. on the following morning. There was already marked purulent infiltration of the surrounding adherent omentum. The gall-stones, dark, slimy bile and pus were very carefully evacuated and an iodoform gauze tail soft tube cholecystostomy drain placed in the anchored gall-bladder, and a cigarette drain in the adjacent peritoneal cavity. Recovery was uneventful and permanent.

This patient stated that she had never before had any pain in the abdomen in her whole life, as far as she could remember, nor any digestive disturbance further than a very occasional transient discomfort from indiscretions of diet, and until this attack had considered herself in perfect health. It might be

mentioned here that she was excessively fat. A second case of this character seen in consultation by Dr. Arthur R. Elliott also made a permanent recovery after operation.

Pressure Pain.—An actively catarrhal gall-bladder with or without stones can in rare cases be entirely devoid of pressure pain or discomfort over the gall-bladder region and yet be the cryptic cause of fever which subsides immediately after a cholecystostomy operation.

Before leaving the subject it might be as well to mention a few of the other right abdominal region colics, *viz.*, pneumonia, referred abdominal colic, pyloric and duodenal colic, snared, hydatid, abscesses, or carcinoma liver colic, inflammation, cystic or carcinomatous pancreatic colic, intussusception, obstruction, diverticulum, intestinal or appendicular (non-peritonitic or peritonitic) colic, paranephritic, nephritic ureteral or urinary-bladder colics, in the female para- and adnexal inflammation or tumor torsion colic—abdominal wall, neuralgia, herpes-zoster, Dercum's or epigastric lipoma or hernia colic.

These and others may have been mistaken for gall-stone colic on some previous occasion, indeed the finding of gall-stones by X-ray or in the fæces or at the operation, is not necessarily positive proof of their having been the cause of the previous colic attack. In *situs transversus* naturally gall-stone colic would be left-sided. Lastly, a true gall-stone colic or cholecystitis may, due to enlargement of the gall-bladder or ptosis, be diagnosed as one of the other colics.

Wandering of Stones.—This has been a matter of much speculation.

(a) Wandering seemed to occur most often in cases in which, due to more or less long standing common duct stenosis only, there had developed a marked hypertrophy of the gall-bladder musculature. The ducts have no musculature to aid in propelling stones.

(b) If a catarrhal endo-cholecystitis and the secretion of a large quantity of mucus occurs, this mixed with bile, makes a very slippery, viscid, duct dilating material, on which the contracting hypertrophic gall-bladder may easily make float, duct passable gall-stones into the cystic and perhaps the common duct, to wander entirely through, or perhaps become impacted.

(c) Wandering via the ducts, does not seem necessarily to occur because of the small size or number of the stones, for in first attack cases often only one large stone was found; unfacetted, that had become impacted in the upper third of the cystic duct. These gall-bladders were usually hypertrophied and contained much slimy bile, and occasionally some blood.

(d) Every surgeon has cases in which he has palpated many quite small stones in the gall-bladder, through a lower abdominal incision, in which there had never been any attack of colic, and perhaps indeeed none occurred for years after the observation, especially if the patient drank copiously of Geneva or other alkaline spring water to keep the bile thin. Quite small stones in a "complete facetted pyramid" of a pear shape, completely filled the gall-bladder in one of the writer's cases; none apparently had wandered.

(e) Stones apparently do not usually wander where dilation and incom-

pensation of the gall-bladder have occurred, despite the excess of slimy bile; nor in cases with but little bile and marked atrophy or concentric hypertrophy of the gall-bladder.

(f) In cases of extremely large bladder stones, or complete atresia of the cysticus, duct-wandering is impossible.

Wandering via fistulæ is illustrated in a recently operated case, in which the gall-bladder and duodenum were so intimately adherent, that in opening what appeared to be the gall-bladder fundus between two tissue forceps, both bladder and gut were opened; reminds me to mention, that those extraordinarily large gall-stones that are occasionally evacuated from the bowel, undoubtedly have been passed via a bimucous gall-bladder-intestinal fistula at some inter-adherent point. At Cook County Hospital one lethal, intestinal obstruction at the ileocæcal valve occurred from a very large fecal stone supposedly of gall-bladder origin. These fistulæ may occasionally also open into other neighboring hollow viscera or indeed through the abdominal wall.

Intra-peritoneal perforation of duct and gall-bladder rupture is predisposed to by impacted stones in old, chronically inflamed friable ducts, and was encountered by the writer, especially in the first part of the cystic duct in five cases.

Rupture of the stone-containing empyemic gall-bladder itself, occurred in one case just before opening it, at its mid-posterior surface while gently raising the liver, with a flat retractor. A most conservative operation in this case resulted in uneventful, permanent recovery, the writer fearing that an extensive operation would result in death from subdiaphragmatic peritonitis.

A friable infiltrated gall-bladder wall is very often accidentally perforated with a sound, gall-spoon or finger, and such perforations are probably often mistaken for spontaneous rupture; but can usually be differentiated as operations-accidents by the absence or lightness of the adjacent peri-cystic peritoneal inflammatory changes present.

Interpretation of Macroscopic Changes.—These if considered immediately on opening the abdomen, in connection with the subjective-objective symptom-complex, often allow of a more correct surgical procedure. In recent years the hurried mechanical technic, and often misleading quotation of percentages, have all too often triumphed in popularity, over the careful, individual pathologic interpretation, and description of the behavior of cases which would tend to instruct the profession and improve the operations prognosis.

The adjacent peritoneum, if inflamed, whether punctate, circumscribed, or general; plastic, serous, or purulent; and also whether recent, or of long standing; by the firmness of the adhesions; although experience teaches us that adhesions may be very firm occasionally in cases of very recent symptoms.

Palpation of the gall-ducts for the presence of duct stones should always be done if possible before opening the gall-bladder, to avoid spreading intra-cystic infection, both into the greater, as well as (by the finger introduced into Winslow's foramen) into the lesser peritoneal cavity.

The unopened gall-bladder gives very important information as to the

different ducts. Simple acute dilatation of the normal gall-bladder by fresh bile, generally indicates a sudden, recent, acute stenosis or atresia of the common duct, with normal or nearly normal patency of the hepatic and cystic ducts, via which latter there is still a very free descent of bile from the liver to the gall-bladder.

Eccentric hypertrophy of the gall-bladder wall is liable to be found present if the common duct has been stenosed only moderately for a certain length of time, before the sudden very marked narrowing or atresia caused by the present exacerbation of inflammation. The cysticus and hepaticus are patent as in the previous case.

Icterus in normal gall-bladder cases with patent hepatic and cystic ducts occurs when a sudden *vis-a-fronte* stenosis communis has caused a dilatation and incompensation of the gall-bladder; or when the atresia communis is complete. If the cysticus alone becomes involved, icterus does not occur so long as the hepaticus and communis remain patent.

The reversal of the bile stream is possible if a marked gall-bladder hypertrophy has occurred, and then the complete atresia communis, by the contractions of the strong hypertrophied gall-bladder forcing its contents backwards via the still patent cysticus and hepaticus into the liver, increasing the intra-hepatic bile pressure and icterus, and indeed aid in causing an ascending cholangitis especially if the cysticus and gall-bladder be infected. Dilatation of the hypertrophied gall-bladder may result later.

Simple atrophy of the normal thickness gall-bladder generally points to a very early catarrhal implication and narrowing of the cystic duct; in this case from the onset of the disease, only a very small quantity of, or no bile from the liver can reach the gall-bladder.

Concentric hypertrophy occurs in cases in which a long standing, moderate stenosis of the common duct had already caused a hypertrophy of the gall-bladder wall. The cystic duct later became so narrowed as to make it impossible for much bile from the liver to reach the gall-bladder.

In a simple atrophy and concentric hypertrophy case icterus may be absent, if both the hepaticus and communis are widely patent, allowing bile to pass unhindered into the intestine; but as the bile has no longer the gall-bladder propulsion, icterus is at least theoretically liable if any communis narrowing whatever occurs.

While hydrops cystidis apparently most often resulted from an early simple atresia cysticus only, either from stone or a very low grade inflammation; an empyema of the gall-bladder usually resulted from primary acute ascending cystic duct inflammation or infection via intestinal adhesions. The adhesions as a cause of gall-bladder infection are probably more frequent than previously supposed.

The condition of the liver should be ascertained by inspection, palpation and if necessary aspiration with smears and cultures after each needle puncture.

The opened gall-bladder gives information as to contents, *viz.*: slime, stones, bile, hydrops or pus, and also to normal thickness or hypertrophy of the wall musculature and as to normal catarrhal or hyperplastic condition of the mucosa. From any of the above, important pathological deductions are possible, as well as indications in the operation.

The Pancreas in Ductitis Communis Infection.—The pancreatic duct also opens at Vater's papilla, or indeed occasionally very much higher up the common bile duct, so that any ascending infection of the common bile duct may be expected to occasionally result in a concomitant ascending pancreatic ductitis; therefore even an apparently slight gall-bladder case, often suffers also from inactivity of the pancreatic digestants and endocrines, as an additional cause of poor health, or indeed in certain types of bile-duct infection, perhaps the pancreas is equally or indeed much more infected than the ducts, gall-bladder or liver. In a case of clinical pancreatitis Dr. Paul Oliver very properly drained the gall-bladder, resulting in recovery.

Indications in Operation.—The chief indications in operations on the gall-bladder as a rule are often far greater for drainage of the cholangitic liver, and indeed the pancreas also, than they are for the drainage of the gall-bladder itself, and such drainage can only be accomplished by a cholecystostomy.

We certainly should hesitate and ponder carefully before performing cholecystectomy, since a cholecystectomy allows of but very imperfect liver drainage of the remaining passive bile pressure, only through the hepatic and common ducts.

These ducts, especially the common, are almost without exception infected and often markedly stenosed, and can drain themselves and the liver bile canals but very poorly and slowly immediately after the operation at the time when free (cholecystostomy) drainage is most necessary to insure recovery. By the removal of a good condition gall-bladder we are doing that which is physiologically contraindicated, *viz.*: mutilation. By the removal of a badly infected empyemic gall-bladder without or with pericholecystitis, we are often unable to avoid extensive manipulation, or the separation of very important circumscribing adhesions, thereby allowing the spreading of intraperitoneal infection, which being subdiaphragmatic is very liable to be lethal, due to the easy and rapid entrance of bacteria from the peritoneal cavity into the subdiaphragmatic lymphatics and even veins.

It is in both light and severe gall-bladder infections that rapid liver and indeed perhaps pancreas drainage also, is most urgently needed to effect a recovery, also many stomach and other symptoms clear that have resisted till then the most careful treatment.

Cholecystostomy.—That cholecystostomy should be in disfavor is not surprising when we consider the unsurgical methods often employed.

Thorough palpation of the ducts for possible duct stones should if possible be performed immediately on opening the abdominal cavity. This can be most easily performed through the short abdominal incision, by the operator standing on the left side of the patient and inserting the left index finger into

the foramen of Winslow. If no stones be found in the ducts the completion of the cholecystostomy operation can be performed without lengthening the incision.

After careful walling off with hot wet pads, aspiration, then apical opening and removal of all bile, mucus, hydrops or pus and stones from within the gall-bladder and first part of the cystic ducts. Diverticulæ should always be searched for. Extreme care should be taken to thoroughly explore the whole of the inside of the gall-bladder and diverticulæ with the index finger to insure the complete removal of all stones and pieces.

The insertion of a rubber tube only into the gall-bladder and purse-stringing it doubly and dropping the entubed gall-bladder back into the abdominal cavity is one of those procedures that has nothing to recommend it. It does not drain, it only permits of an overflow of stagnant bile, and should be abandoned because it allows of about four inches of bare tube for intestinal-omental adhesions to form around. These adhesions extend from the gall-bladder fundus upwards to the parietal peritoneum where the tube passes through the abdominal wall.

First. This stretch of adhesions is not a commendable operation—result functionally for either intestines or gall-bladder.

Second. Future accessibility of the gall-bladder is a very important necessity for both liver and pancreas and is made almost impossible by this procedure. In one case which came under my observation though operated elsewhere, the tube became loosened and the patient died of peritonitis.

Parieto-Cystorrhaphy.—The much more correct cholecystostomy operation is that in which the gall-bladder fundus is sutured to the parietal peritoneum.

If all of the stones are carefully removed and the cystic duct is or becomes patent, this operation, done properly, never resulted in a permanent fistula in any of the writer's cases.

After removal of all the gall-bladder contents as above described, the writer inserts a soft rubber tube through the abdominal wall opening into the gall-bladder. Through this tube, a long tail of iodoform gauze passes loosely, and with this tail, the gall-bladder is first packed to within one-half inch of the bladder fundus opening, into which latter the tube is now inserted. The gall-bladder and parietal peritoneum are united together by catgut sutures. The closure of the abdominal incision around the protruding tube and its gauze wick completes the operation.

This iodoform pack allows of some capillary drainage and impregnates the gall-bladder with an antiseptic applied directly to the gall-bladder mucosa, promoting early patency of the infected cystic and common ducts so that in many cases of hydrops and empyema cystidis, bile was already saturating the dressings within twelve hours.

That gall-stones will reform in the unremoved pathologic gall-bladder is always possible but is not necessarily a fact, but if stones do form they can be easily removed from an anchored gall-bladder. After operation the patient

needs careful instructions in diet, exercise, etc. Thus far among the cholecystostomies performed by the writer there have been no cases of recurrence of stones brought to his notice.

The consideration of the question of intrahepatic and pancreatic drainage for infections, so outweighs the question of the reformation of stones that in the opinion of the writer there is little room for discussion. One of the principal reasons why cholecystostomy fails in certain cases is that too early closure of the fistula occurs and the insufficient drainage gives only an abortive operative result.

The Cholangitic Infections.—The low grade ascending catarrhal common and cystic duct and gall-bladder infection is very often accompanied by a low grade cryptic hepatic duct and intra-hepatic duct infection or cholangitis. In many cases this cholangitis is entirely symptomless subjectively and objectively and has been so overshadowed by the more evident cholecystitis and gall-stones as to have been neglected. It certainly deserves closer study by the surgeon and diagnostician in life and by the laboratory workers, both in life and post-mortem.

If an acute exacerbation or extension of a fresh infection occurs, a rapid ascent by continuity upward from the ducts into the liver bile canals is always possible with the formation of multiple intra-hepatic foci of infection or indeed intra-hepatic abscesses, and death.

Death from the so-called "ptomaine poisoning" has occurred all too frequently of late years; often indeed without any diagnosis of the real cause of death if no autopsy was made; and indeed often when an autopsy was made; if there was found some slight focus like a broncho-pneumonic patch or other lesion to give as a cause of death.

Acute cholangitis often occurs suddenly in adult people, rich and poor, often indeed in the prime of life and apparently till then in robust health; demanding careful regulation of food sales and preparation and handling in eating houses, especially in these days of canning and cold storage preservation. The writer has had come under his observation recently five deaths, in some of which he has actually seen the microscopic sections, and while it was some satisfaction to have a laboratory post-mortem diagnosis, there is much need of awakening greater clinical interest and study of these cases, of which I give here the history of two.

Case I.—A. I., age twenty-three, married, primapara, baby delivered (midplane), forceps by the late Dr. W. W. Jaggard. Anæsthetic A. C. E. mixture by the writer. The puerperium ran a normal course. The young, nursing mother had been up and about for three weeks in apparently normal health and one evening partook of a hearty supper of canned salmon, of which she was inordinately fond. That night violent abdominal pains, vomiting, chills, high fever and diarrhœa occurred. The urine was negative except for a very copious amount of urates.

Notwithstanding the history of the onset, the fact of having recently passed through childbirth caused among the well-to-do laity and friends, and even some of the unthinking profession, an unjust suspicion of puerperal sepsis, till

ruled out by pelvic examination by the late Christian Fenger. The autopsy performed by the late Dr. Stanley P. Black showed the cause of death to have been acute abscesses of the liver.

There were some slight evidences of an old appendiceal inflammation having occurred years previously, but showed no signs whatever of any recent activity; yet the vermiform appendix, which was under suspicion in those days as being the cause of so much abdominal trouble in young adults, was consequently considered the probable place of origin of the liver emboli.

The cause of death in this case was undoubtedly acute gastro-enteritis from canned salmon and ascending ductitis and angiocholitic abscesses.

Case II.—P. B. Male, waiter, Greek, age thirty-two, always considered himself in good health until this attack. Admitted first to Alexian Brothers Hospital after eating "warmed up" soup at a first-class downtown hotel. Soon after eating he was taken with vomiting, violent pain in the pit of the stomach, diarrhœa, with frequently two or even three chills in twenty-four hours followed by temperature of 105° and over. From the history and a subjective and objective physical examination the writer was convinced that the man had an ascending infection of the liver or pancreas or both. The family removed the patient to the Passavant Hospital, March 31, 1915, and placed him in my care. Dr. Robert B. Preble in consultation agreed as to the absence of sufficient findings in the lungs, to cause the symptoms, and agreed to exploratory operation.

An exploratory operation was done, April 10, 1915, by the writer; vertical incision near the outer border of the right rectus muscle. Inspection, palpation and needling of liver, failed to locate pus. The gall-bladder contained much slimy bile only, but the diagnosis of possible ascending biliary hepatitis and abscesses of the liver was still adhered to. Cholecystostomy was performed by the opened gall-bladder being stitched to the abdominal peritoneum and iodoform gauze pack and tube drainage, which was promptly followed by a cessation of the chills and marked moderation of the fever temperature, which now ranged from 100° to 101°. Death occurred May 24th. Following each introduction of the needle, cultures should be made in these cases, as thus the diagnosis of biliary infection could often be made.

The autopsy revealed many Spanish nut to larger sized abscesses of the liver, showing that finding and draining one, two or three of the larger abscesses would be useless. The coroner's physician at a second autopsy confirmed the findings of liver abscesses, but despite this the coroner instructed the jury to bring in a verdict of death from pulmonary tuberculosis because of the presence of one small tubercular focus in the upper part of one lobe.

CERTAIN ASPECTS OF SURGERY OF THE GALL-BLADDER*

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Gall-bladder surgery has passed through various stages of evolution to the present generally accepted operative procedure. Formerly, there was a tendency to extreme conservatism, and only very badly diseased gall-bladders were removed. Even when stones were present, the gall-bladder was drained and left intact. It was soon found that in a notable percentage of such cases stones and cholecystitis recurred, and the patient derived no benefits from the operation. Hence, secondary operations were not at all rare, and finally after a second or third ineffective operation, the gall-bladder had to be removed to relieve the patient. Such observations have led most surgeons to remove the gall-bladder, if feasible, at the first operation. Thus primary cholecystectomy came to be preferred to cholecystostomy. But so long as the true function of the gall-bladder remains a subject of controversy there will be discussion with regard to the better surgical procedure.

Since the early eighties various theories have been advanced regarding the part played by the gall-bladder in the scheme of the human machine. Some have believed it to be a vestigial organ like the appendix, whose usefulness belonged to a past period in the evolution of man; others believed it to be a reservoir in which the bile changed its chemical composition to some unknown quality better suited to promote the process of digestion. Others believed it to be a mere storehouse for bile, and therefore, capable of distending, without the knowledge of the individual, to many times its ordinary capacity. Dr. W. J. Mayo disputed this assertion on the ground that the gall-bladder with a normal storage capacity of one ounce, would be of very little use as a reservoir, since in twenty-four hours as much bile would pass through it as urine through the urinary bladder. If the gall-bladder is intended to hold such large quantities of bile, why is it that we find no special mechanism, no inherent propulsive power like that of the urinary bladder? The ejection of the contents must necessarily go on mechanically without interruption and at certain intervals, since an hour's secretion of bile is sufficient to fill this organ to its normal capacity.

There has been much controversy concerning the manner of expelling the bile. Ardent advocates of cholecystostomy attribute this process to the rhythmic contractions of the wall of the gall-bladder, and do not look farther for the cause of the distended organ than in the disturbance of this mechanism, and hope to overcome it by a drainage operation. In recent years it has been demonstrated that the force of the contractions of the gall-bladder

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does not materially exceed the maximum secretion-pressure of the bile, and, therefore, is not sufficient for the task. The gall-bladder's function, it seems, is only to change the escape of bile into the intestines from a more or less continuous flow to an intermittent one.

Thus, at the present time, we are prone to believe that neighboring organs must assist greatly in the expulsion of the contents of the gall-bladder. Sweet and his followers assert, "The gall-bladder empties itself by the pressure of the liver and the distended stomach, during digestion, and by the milking action of the peristaltic waves that pass down to the duodenum."

Whether the gall-bladder empties itself or is emptied by neighboring organs, the fact remains that it must be emptied regularly, and experience has shown that we are unable to reëstablish a lost function by temporary drainage operation. There remains no other procedure than to remove the organ, which, if once incapacitated, can be of no further use, and is likely to become a hotbed for all kinds of bacteria. Aside from the exit of bacteria into the duodenum, through the cystic duct, the organisms may be picked up by the abundant network of lymph channels in the deeper and superficial structures of the gall-bladder, and carried on to innocent adjacent organs. These lymph channels empty into two main vessels that communicate freely with the glands at the head of the pancreas. Therefore, cholecystitis may sooner or later be associated with pancreatitis.

Congestion of bile in the gall-bladder naturally promotes infection. When the wall of the gall-bladder in man is once infected and inflamed, it has little inherent resistance, owing possibly to its architecture and position, which make free and spontaneous drainage difficult. Infection also undoubtedly interferes seriously with its main function, namely its inherent influence on the flow of the bile. A diseased gall-bladder cannot contribute the something, possibly mucus, which plays an important part in the propulsion of its contents, especially when the cystic duct is of small calibre owing to inflammatory thickening of its walls.

When cholecystitis, with or without stones, is present, cholecystectomy, with perhaps a few exceptions, should be the operation of choice. I am convinced that in some of these cases, we are forced to depend largely on the clinical history of symptoms, besides examinations revealing definite tenderness over the gall-bladder area, rather than on the gross operative findings. "Interval" operations on gall-bladders without stones are most misleading; that is, when the acute attack has occurred two or three months before operation, and, through the natural resistance of the organ to disease, any gross evidence of disease has temporarily cleared up. Unlike the interval appendix operation, there is in many cases of cholecystitis without stones an absence of the telltale adhesions and thickening which follow acute appendicitis.

Thus, on examination there may be no thickening of the gall-bladder to palpation, no evidence of hepatitis, and no enlarged glands along the cystic duct, and yet there may be, lurking in the walls of the gall-bladder, an infection which will insure a recurrence of the typical gall-bladder attacks which

have caused the patient to consult his physician. It is not surprising that often the surgeon omits the radical operation on account of the lack of sufficient visible evidence of a diseased gall-bladder. Such patients invariably return, complaining of the same annoying symptoms for which they primarily sought relief.

I am convinced that a certain percentage of gall-bladders assume such a normal appearance between attacks, that it is practically impossible, from a gross examination of the organ during such intervals, to determine absolutely whether or not it is diseased. Fortunately, this percentage may be reduced by careful examination of adjacent and associated organs.

It is wise to bear in mind that when the gall-bladder is once infected it has little inherent resistance to overcome an infection and may become a hotbed of bacteria. Illustrative of this is the typhoid carrier, in whom the bile in the gall-bladder and the wall of the organ itself are the fields which harbor typhoid bacilli for years. I have in mind a patient of this type, who had had typhoid fever about four years before she came under my observation as a carrier. She was a housemaid, and eleven cases of typhoid fever developed in the family in which she was employed. Typhoid bacilli were found in her stools on repeated examinations. I secured the coöperation of the health department, and she was instructed how to protect those about her from infection, and was told that she could not take a position; she was thus more or less isolated, and naturally very unhappy. I had a conference with Doctor Read, the Director of Health in Seattle, and it was decided to advise cholecystectomy, since we believed that the gall-bladder was harboring the organism. At first the patient refused operation, as she had not had any definite abdominal symptoms; but consented rather than to be deported as a menace to the community.

At operation the gall-bladder was found somewhat distended, and it contained several small stones. The gall-bladder and the appendix were removed. Bacteriologic examination of the bile showed that it contained typhoid bacilli. Examination of the stools three weeks after operation did not reveal typhoid bacilli, and on repeated examinations none were found. At the end of three months the patient was released as no longer a menace to the community.

This case again illustrates, in a small way, the inherent lack of resistance of the gall-bladder in overcoming infection, and the manner in which the bile may act as a culture medium in an infected gall-bladder.

It is interesting to note to what extent the gall-bladder will distend in some cases without rupture. I recall one case of stone obstructing the cystic duct in which the gall-bladder was fully 25 cm. long, and could be felt before operating in the right iliac region. In such cases it is reasonable to assume that the wall of the gall-bladder is not badly diseased at the time of obstruction; otherwise, it could not withstand such enormous distention without rupturing.

Indications for Operation in Diseases of the Gall-bladder.—Cases of acute or chronic cholecystitis, with or without stones, are essentially surgical. The time of operation must be decided in each case, depending on the patient's general condition. In many cases it is better to tide the patient over the acute attack until the severity of the infection has subsided. This procedure can not be followed in all cases however, as in the acute fulminating types, in which rupture of the gall-bladder is imminent, operation must be resorted to at once.

There are certain types of cases in which cholecystostomy may be the operation of choice: (1) when the general condition of the patient is so serious that it is unsafe to subject him to more than an absolutely necessary operative procedure; (2) when there is imminent danger of stricture in the common duct following operation, as in these cases it may be necessary to perform a cholecystduodenostomy at a later date; and (3) in cases of common duct obstruction when jaundice has been longstanding with consequent impairment of the patient's health and coagulability of the blood is delayed and when the cystic duct is patulous and jaundice can thereby be relieved by drainage; hemorrhage in these cases is a serious complication, and by performing the least serious operation the danger is less imminent.

Except in the foregoing conditions, cholecystectomy should be the operation of choice, as in practically all seriously diseased gall-bladders, function is largely lost and we are only likely to be forced to the operation of removal at some future time, if the so-called more conservative operation of cholecystostomy is done primarily.

Complications that have followed operations on the gall-bladder and ducts have been varied. Injury to the hepatic and common ducts in clamping off the cystic duct has often been reported, resulting in biliary fistula or partial obstruction of the common duct from stricture. Surgery of the gall-bladder is apt to cause dense adhesions that may obstruct the pyloric end of the stomach or intestines and demand a secondary operation. I was once compelled to perform a gastro-enterostomy six weeks after cholecystectomy, on account of adhesions that almost entirely obstructed the duodenum.

The procedure of choice in operations on the gall-bladder is first to sever the cystic duct and work upward to the fundus; this method is described by Judd. In large thickened gall-bladders, or when adhesions are very dense, due to previous operations, it is necessary to work from the fundus toward the ducts.

REMOVAL OF A RETENTION CYST FROM THE LIVER*

By John F. X. Jones, M.D.
of Philadelphia

Case.—M. P., a white, unmarried female, between seventeen and eighteen years of age (her mother stated that the patient was born September 24, 1904), was admitted to the Misericordia Hospital, May 10, 1921, because of a painful swelling of the abdomen. Two months previous to her admission the patient had noticed, for the first time, an enlargement of the abdomen. Thereafter, her abdomen increased rapidly in size and, at times, became so painful as to prevent her from attending to her usual affairs.

Three months before entering the hospital the patient had experienced (according to her statement) an attack of vomiting which lasted three days. With the exception of this one occasion there had never been either nausea or vomiting. There had been no irregularities of menstruation. Her abdomen had never been subjected to trauma. Neither family nor personal history suggested a possible cause for the existing tumor. The patient's appetite had been good and her bowel movements regular. There was but one subjective symptom—pain referred to the vicinity of the abdominal tumor.

On May 11, 1921, after having ascertained that her urinalysis was negative, her temperature 98⅘° F., her pulse 80 and her respirations 20, a physical examination was made of a well-nourished young woman who was about five feet in height and who weighed 124 pounds. Her sclerotica and skin were clear (here it may be emphasized that neither before nor after operation had there been jaundice in this case). Her teeth were in excellent condition; her tongue slightly coated; her tonsils had been removed. There were no alterations in the breasts; no skeletal changes. Her extremities were normal and of firm musculature. Investigation of the respiratory, circulatory and nervous systems was negative.

The abdomen alone seemed affected, and was so obviously abnormal as to focus the vision promptly upon an oval tumor projecting in the midline. The lower border of this tumor could be felt about one and one-half inches below the umbilicus, and apparently had no connection with the pelvis or the pelvic contents. Above, the tumor seemed lost under the transverse colon which I fancied I could percuss distinctly. I could not, however, feel the margin of the liver. Laterally, the tumor extended about three inches beyond the median line on each side. It could be moved very slightly from side to side; it could not be depressed; it could not be moved up or down. It fluctuated and was sensitive. The abdominal wall could be moved over the tumor. I was able to palpate neither spleen nor kidneys. I believed that I was dealing with an intraperitoneal cystic tumor, but I did not even suspect its connection with the liver. An exploratory laparotomy was decided upon.

The operation was performed under ether on May 13, 1921. From a point two inches above the level of the umbilicus to a point the same distance below the level of the umbilicus, a straight incision was made through the right rectus muscle. As soon as the peritoneum had been opened the summit of a large, grayish-white tumor appeared in the wound. This cystic mass having been partially delivered from the abdomen, I was able to feel a normal uterus with normal ovaries and tubes, to palpate the intestines beneath (behind) the tumor and to

* Read before the Philadelphia Academy of Surgery, October 9, 1922.

outline the lower pole of an apparently normal right kidney. The hepatic origin of the tumor became apparent. The abdominal incision was enlarged upward to the right costal margin, when it could be clearly seen that the cyst sprang from about three inches of the sharp anterior margin of the left lobe of the liver. The gall-bladder apparently had never been inflamed, was easily compressed and contained no calculi.

In order to remove the cyst and its base it was necessary to excise a considerable portion of the anterior margin of the left lobe of the liver. Having walled off the underlying peritoneum from the liver by means of plain gauze pads, the anterior margin of the left lobe of the liver was compressed between four Péan hysterectomy clamps, two applied from each side of the left lobe. Both the proximal or upper two clamps and the distal or lower two clamps were applied, two from each side, in such a manner that their points crossed each other at a perpendicular line drawn through the centre of the anterior surface of the left lobe of the liver. The proximal or upper two clamps compressed the left lobe of the liver one and one-half inches above (behind) its anterior margin. The distal or lower two clamps compressed the left lobe of the liver one inch above (behind) its anterior margin. Then the left lobe of the liver was severed transversely by cutting through the liver tissue between the proximal or upper two clamps and the distal or lower two clamps. The distal clamps now held one inch of the excised anterior margin of the left lobe of the liver—or the base of the cyst—and the cyst; while the proximal clamps controlled the left lobe by reason of their position immediately above the cut surface of the liver.

The electric cautery was applied to the cut surface of the liver. Interrupted, interlocking, mattress sutures of number two chromicized catgut, doubled, were inserted through and through the liver tissue on the proximal side of the two remaining clamps. Not having at hand one of the needles especially devised for liver suturing, a large full curved needle, with round shank, was used, and the blunt (eye) end was inserted close to the clamps. The sutures were tied firmly but not tightly. Next, the clamps were removed. There was no hemorrhage. The abdominal wall was sutured in layers without drainage. Dr. J. Nall assisted. Miss S. G. Murphy anæsthetized.

Immediately following operation the rate of the pulse increased to 148 and remained this rapid during the following day; on the 15th it slackened to 100; on the 16th it accelerated again to 140; on the 17th it was 100; on the 18th it was 80, where it remained. The day after the operation the temperature ascended to 101° F. where it remained for three days, when it returned to 98⅘° F. The respirations were 40 on the day after operation; 20 on the 15th; 28 on the 16th; 20 on the 17th and thereafter. Apart from these temporary irregularities of pulse, temperature and respiration, and with the exception of a transient albuminuria, which I believe was due to ether irritation, post-operative recovery was uncomplicated. On May 21, 1921, the stitches were removed by Dr. J. Hudock and healing was by first intention. On May 29, 1921, sixteen days following operation, the patient was discharged from the hospital.

When the patient was last examined, on July 21, 1922, over fourteen months following operation, there was no sign of recurrence of the cyst, the operation scar was firm, there was no evidence of hernia, the liver could not be palpated, the patient weighed 124 pounds, had no symptoms, subjective or objective, and was able to attend to all of her affairs without any inconvenience.

Following is the report of Dr. John D. Paul, the pathologist to whom the cyst was submitted for examination.

"The specimen is a grayish-white ovoid mass hanging from a pedicle. The mass fluctuates as though it contained fluid and measures 19 cms. in length and 10 cms. in its greatest diameter. When cut, the mass was found to contain 990 c.c.

of a dark greenish viscid fluid which gave the characteristic chemical reactions for bile. Cultures of this fluid were sterile after ten days' incubation. The remainder of the fluid was centrifuged and the sediment carefully examined for the presence of echinococcus hooklets, but none could be found. After opening the mass, the wall was found to consist of a very tough, thin, opaque material resembling fibrous tissue which was grayish-white on the outside and yellowish-brown on the inside.

"Microscopically (Fig. 1), this wall was composed of a thin layer of dense fibrous tissue lined on its inner surface with a single layer of low cuboidal epithelium. In many places, this lining epithelium had desquamated, leaving only the fibrous tissue wall; while, in other places, an occasional duct-like formation was found imbedded in the wall, suggesting the remains of small bile-ducts. Diagnosis: Retention cyst of the liver. This specimen was also examined by Dr. Allen J. Smith, who made the same diagnosis."

Dr. George D. Fussell, of the Misericordia Hospital, made a special examination of the portion of the liver removed with the cyst. Doctor Fussell's report follows: "The liver lobules are outlined by dense fibrous tissue. The liver cells are small and atrophied, the atrophy being most marked in the periphery of the lobules. The cytoplasm of the liver cells is pale; the nuclei are relatively larger than normal, but actually smaller and deep staining. The intercellular spaces are wide and contain many fibroblasts and fibrils of connective tissue. The fibrosis is especially marked about the vessels and ducts."

For the microphotograph of a portion of the cyst wall (Fig. 1), I am indebted to Dr. S. P. Reimann of the Lankenau Hospital.

Among those who have classified non-parasitic cysts of the liver are: Hanot and Gilbert (Études sur les Maladies du foie, Paris, 1888), Bland-Sutton (Tumors, Innocent and Malignant, 5th Ed., 1911), C. Langenbuch (Chirurgie der Leber und Gallenblase, Deutsche Chirurgie, Lieferung 45 h. 1897), J. Forbes (Saint Bartholomew's Hospital Reports, 1898, vol. xxxiii, pp. 181–227), F. Leppmann (Deutsche Zeitschrift für Chirurgie, 1900, vol. liv), E. Schwartz (Chirurgie du foie, 1901, cited by Fieschi), B. Kilvington (Intercolonial Medical Journal of Australasia, 1902, vol. iii), C. B. Blackburn (Transactions of the Pathologic Society of London, 1904, vol. lv), Rolleston (Diseases of the Liver, Gall-bladder and Bile-ducts, 2nd Ed., 1912), D. Fieschi (La Clinica Chirurgica, Milano, 1909, vol. xvii), Tuffier (Bull. et mém. soc. de chir. de Paris, 1912, vol. xxviii) and Sidney Boyd (The Lancet, London, April 5, 1913, vol. i).

The writings of these authors have led me to believe that non-parasitic cysts and non-parasitic cystic formations of the liver may be divided into: 1. Teratomatous or embryomatous cysts. 2. Pseudocysts. 3. Lymphatic cysts. 4. Cystic degeneration of the liver with cystic kidneys. 5. Cysts which arise from blood-vessels. 6. Cystadenoma. 7. Ciliated epithelial cysts, and 8. Retention cysts.

1. Meckel's case of "dermoid cyst of the liver" has been cited by Hanot and Gilbert, C. Hoffmann (Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie, Jena, 1902, B.X), Leppmann and C. Langenbuch. The last-mentioned writer says: "Dermoid cysts, which of course are congenital in origin, can develop in the liver—at least Meckel reports, from the dissection

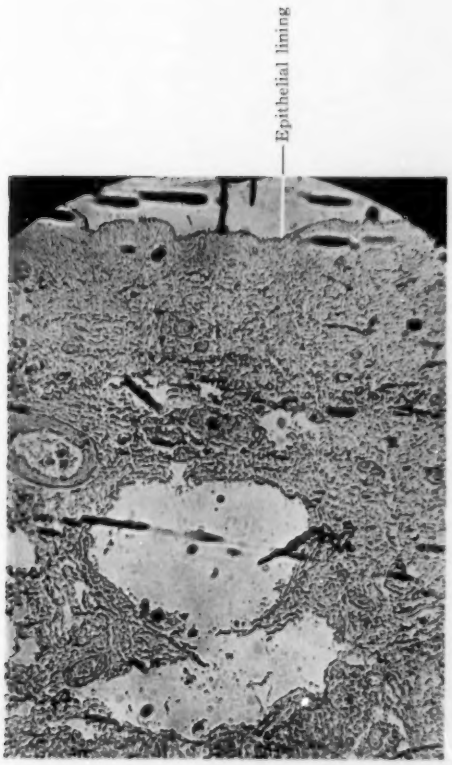

FIG. 1.—Microphotograph of portion of wall of cyst removed from the liver.

of a dropsical man in whose liver was found a cavity filled with cartilaginous elements, hair and a greasy, pappy mass." Rolleston's action, in placing this case under the heading "Embryomas and Teratomas," seems in accord with the views of the more modern pathologists. Adami and Nicholls (The Principles of Pathology, 1909, vol. ii, p. 862) believed that the term "dermoid" had lost much of its significance and might be misleading. "It is commonly held, for example," these authors stated, "that the dermoids are cysts composed of more or less modified skin with other structures of epidermal origin. Careful study has shown, however, that even the simplest of them contain structures from the other primitive germ layers." Consequently, the distinction between "dermoid and teratoma" is an artificial one, and had better be discontinued. It is simpler and more correct to class all the growths of this kind under one generic term "teratoma." W. G. MacCallum (A Text-book of Pathology, 2nd Ed., 1920, p. 1081), under the heading of "Dermoid Cysts," wrote: "They are, as the name implies, composed essentially of derivatives of the ectodermian layer, but there is no line between them and the more complex teratomata—indeed, all dermoids on closer examination prove to have a more complicated structure than is apparent at first sight." J. Ewing (Neoplastic Diseases, 2nd Ed., 1922, p. 966) writes: "It is especially difficult to distinguish between certain complex dermoids and teratoid growths with predominance of ectoderm." Rolleston (Diseases of the Liver, etc., p. 468) cites the literature on these conditions. W. T. Reynolds (The Medical Herald, St. Joseph, April, 1912, N. S., vol. xxi, p. 168) has reported a case which seems to belong to this group. In this cyst Reynolds found hair and part of the cyst-wall contained stratified squamous epithelium and a hair follicle.

2. Under "pseudocysts" may be grouped cystic degenerations of carcinoma and of sarcoma, softening of cirrhotic nodes and cysts due to hemorrhage. The case of Lisyanski and Lyudkevich (see below) apparently was one of pseudocyst after hemorrhage.

3. Lymphatic cysts of the liver may occur. Stengel and Fox (A Text-book of Pathology, 1921, p. 709) write: "Occasionally small cysts are seen which suggest origin from dilatation of the lymphatic channels." Lymphatic cysts, according to E. Ziegler (Lehrbuch der Allgemeinen und Speciellen path. Anat., vol. ii, Jena, 1892), are very rare. Leppmann says that they contain clear, watery, yellowish fluid, with albumen and a large percentage of sodium chloride. They do not contain bile and are lined with endothelium. As a rule, they remain insignificant in size.

4. The association of cystic kidneys with cystic degeneration of the liver was first observed by J. S. Bristowe (Transactions of the Pathological Society of London, 1856, vii).

Of the eighty-five cases of non-parasitic cysts collected by Eli Moschcowitz (The American Journal of the Medical Sciences, April, 1906, N. S. cxxi) the liver alone was involved in ten only. Moschcowitz says that this disease occurs at all ages and in his collection was found twice in the fœtus, seven

times in the newly born, four times in the first year, and, thereafter, at various ages up to eighty-one. According to Rolleston (The Oxford Medicine, vol. iii, 1921) this condition may be easily overlooked in infants unless the liver is subjected to microscopic examination. Cystic kidneys are common without any involvement of the liver, but cystic disease of the liver is nearly always accompanied by cystic kidneys. Sometimes, not often, there are also cysts in other organs, such as the spleen, pancreas or ovary. In infants the cysts may be entirely microscopic, or very minute, and the liver normal in size. In adults the cysts are of various sizes and enclosed in fibrous capsules and the liver may be greatly enlarged. Microscopically, the cyst-wall from the infant has dilated tubules lined with subcolumnar epithelium and surrounded by fibrosis. In the adult the microscopic picture is similar but, of course, the cells are more advanced in age. In the smallest cavities the epithelium is columnar; in those of medium size it is low and cubical; in the larger cysts the cellular lining may be absent or consist of an incomplete layer of flattened cells (Kilvington). The fluid from such cysts is usually clear, albuminous and free from bile; sometimes cholesterin, leucin, blood and creatinin are present (Rolleston). Moschcowitz writes: "Although non-parasitic cysts of the liver are most commonly met with as post-mortem surprises, they nevertheless possess definite clinical interest." He cites well-known cases where the cyst in the liver of a fœtus was so large as to obstruct delivery and says that, if they grow very rapidly they may cause a severe, constant pain in the hepatic region. Clinically, there is neither jaundice nor ascites in these cases, and in the absence of enlargement of the liver or of a definite tumor there will be no symptoms ascribable to the liver. Of course, enlarged liver and kidneys, when present with uræmia will suggest the diagnosis. The treatment is that of chronic nephritis. Rolleston believes that operative drainage of such a liver ought to be avoided. H. Kehr (W. T. Bull's Translation of "A System of Practical Surgery," by Bergmann, Bruns and Mikulicz, vol. iv, 1904) taught that, if such cystic disease were found on exploratory incision, the abdomen ought to be closed at once.

Theories on the origin of cystic disease of the liver have been numerous. Prominent among those who have either advanced or reviewed such theories are: P. H. Pye-Smith (Transactions of the Pathological Society of London, xxxii, 1881), Sabourin (Archives de Physiologie normale et pathologique, 1882, vol. ii, and Progrès Médical, May 17, 1884, No. 20), G. H. Savage and W. Hale White (Transactions of the Pathological Society of London, 1884), G. F. Still (Transactions of the Pathological Society of London, xlix, 1898), Leppmann, Rolleston, Kilvington, Blackburn, Eli Moschcowitz, Fieschi, von Hippel (Virchow's Archiv, cxxiii), Ribbert (Verhandlungen der Deutsche Pathologischen Gesellschaft, 1899), Siegmund (Virchow's Archiv, cxv), Borst (Festschrift der Physicalisch-Medicinische Gesellschaft, Würzburg, 1899), H. Coenen (Berl. klin. Wochenschrift, 1911), Sidney Boyd and J. Ewing. I shall merely outline those theories which have attracted the most attention. According to Moschcowitz, the earliest theory is the inflam-

matory theory of Förster, who regarded these cysts as dilated bile-ducts shut off from the general biliary circulation by inflammatory growth of new connective tissue. Pye-Smith thought that vacuolation of liver cells fused and thus formed cysts. Sabourin believed that these cysts developed in two ways: The first variety, from preëxisting bile-ducts; the second variety, from new canaliculi. The second variety were veritable biliary angiomata growing apace with a process of cirrhosis. Eli Moschcowitz discovered in the fibrous tissue of the portal spaces of cystic livers aberrant bile-ducts which do not exist in normal livers. George F. Still held that, while the bile-ducts proper are developing normally, certain hypoblastic cells, instead of performing their normal function of helping to form part of the duodenal diverticulum, engage in the manufacture of cystic tubes. The excess of fibrous tissue, often considered inflammatory, Still believes, is persistent mesoblastic stroma. Ewing (Neoplastic Diseases, 1922) says that any neoplastic element present is more probably adenomatous than fibrosarcomatous, as suggested by Rindfleisch. Ewing writes: "A congenital malformation is undoubtedly the original factor."

5. The possibility of cystic formation in the liver arising from blood-vessels, according to Kilvington, cannot be denied. The pathological report upon John B. Deaver's case of cyst of the liver was "hæmangioma."

6. Either the single adenoma or the multiple adenomata of the bile-ducts may become cystic (Rolleston). The cystic cavities are epithelial-lined and contain clear or turbid fluid which is albuminous and varies in color. Ewing questions the neoplastic nature of some of Leppmann's reported cases. Ewing writes: "A true multilocular cystadenoma was successfully removed by Keen. It weighed 113 gms. and contained many cavities lined by cylindrical cells and supported by fibromuscular tissue."

7. Ciliated epithelial cysts of the liver have been described by Girode (Études sur les Maladies du foie, 1888, p. 295, Hanot and Gilbert, cited by Tuffier), N. Friedreich (Virchow's Archiv, Band xi), Eberth (Ibid., Band xxxv), F. von Recklinghausen (Ibid., lxxxiv) and by F. W. Zahn (Ibid., 1896, cxlxxx, p. 175). They are unilocular, not larger than a walnut and free from bile. Their usual location has been upon the anterior surface, near the suspensory ligament and along the inferior border (Ewing). Zahn says that they are just beneath the liver capsule. Von Recklinghausen thought that they were mucous retention cysts. Zahn believes them to be the result of an unknown embryonal formation. Ewing says that their origin is not readily explained. Leppmann, after describing them in a separate division, states that they must be included with the retention cysts.

8. "Retention cyst" is the histological diagnosis of the case recorded in this paper. A retention cyst of the liver is due to the engorgement of a bile-duct. Virchow (Die Krankhaften Geschwülste, Berlin, 1863) said that either calculi or cicatrices prevented the duct from emptying itself, but made no mention of the epithelium which, Leppmann thinks, is to be considered. In the case reported there has been no sign either of stone or of scar and

there has been no history either of trauma or of inflammation. It is possible that an unrecognized irritation has caused swelling and hypersecretion in a bile-duct, with occlusion of its outlet. In the cases studied by Adami (The Principles of Pathology, 1908, vol. i, p. 788) there had always been a marked degree of fibrosis around the bile-ducts in the immediate neighborhood of the cysts. The ease with which the liver was sutured suggests that there was some degree of fibrosis present. These cysts have contained serous or mucous fluid, or, as in the case reported, bile.

The diagnostic methods employed to differentiate a hydatid cyst of the liver from a cyst, tumor or accumulation elsewhere in the abdomen, are equally applicable to the non-parasitic cysts of the liver and are set forth in detail in several text-books.

Whether a cyst of the liver be hydatid or non-parasitic it is impossible to determine until the fluid, at least, from such a cyst and, perhaps, also its wall have been examined. Puncture of a suspected hydatid through the abdominal wall is no longer permitted by the teachings of modern surgeons. Such a procedure may be followed, immediately, by urticaria, convulsions, collapse or even death; and more remotely, by peritonitis, or secondary implantation of daughter cysts. The fluid from a living hydatid cyst is said not to be toxic but, before tapping a cyst, it is impossible to tell if it be alive or dead. Symptoms from the living hydatid fluid have been ascribed to anaphylaxis (Rolleston, The Oxford Medicine, vol. iii, 1921). Rapidly increasing familiarity with the technic of local anæsthesia would seem about to abolish any excuse for tapping abdominal cystic tumors without preliminary laparotomy.

Examination of the fluid alone will reveal the parasitic character of most hydatid cysts. In the sterile hydatid, however, no reproduction having occurred and the fluid being free from scolices, hooklets or daughter cysts, identification necessitates microscopic study of the cyst wall. Many years ago Sir Benjamin C. Brodie (Lectures, London, 1846, p. 105) discussed two very interesting cases. It seems that in 1822, with a flat trocar, he punctured a tumor in the right hypochondriac region of "a young lady about twenty-three years of age." Three pints of watery fluid were evacuated. Six years later there had been no return of the tumor. A few months after he had treated the lady, he tapped the same region of a boy about twelve and drew off a pint and a half of the same kind of watery fluid. He believed that he had been dealing with two cases of non-parasitic cyst. Mr. Hawkins (Medico-Chirurgical Transactions of London, vol. xviii, p. 118), in reporting these two cases, stated that the fluid from each case was not coagulated by heat. George Budd ("On Diseases of the Liver," 3rd American Edition, Phila., 1857, p. 464) thought that both these cases were probably instances of sterile hydatid cyst. The fluid from a living hydatid cyst contains no albumen, is colorless and among other ingredients has succinic acid and sugar. Scolices and hooklets are not free in the living cyst, but become detached on the death of the parasite or are dislodged by paracentesis. After the parasite dies the

fluid in the cyst becomes turbid, albuminous and toxic (mytilotoxin). The fluid from a non-parasitic cyst contains albumen, varies in color, may have other components in addition to albumen, but does not contain sugar, succinic acid or, of course, any of the hydatid elements.

On section the typical hydatid cyst is found to be composed of an outer capsule, or ectocyst or adventitia and an inner membrane or endocyst which, with its burden of daughter cysts, may be readily shelled out by the hand of the operator. The ectocyst has a characteristic laminated appearance. The non-parasitic cyst is usually, not invariably, lined with epithelium or endothelium.

Because of its low tension compared with that of a hydatid cyst, F. Bird (Kilvington) suspected a fluid tumor of the liver to be a non-parasitic cyst. This suspicion was confirmed by a successful operation.

Rolleston (Diseases of the Liver, etc.) warns us that during an operation the anatomical relations of the cyst must be noted in order to differentiate it from idiopathic dilatation of the extrahepatic bile-ducts. According to Erik Waller (ANNALS OF SURGERY, 1917, vol. lxvi, p. 446), when it becomes evident that the sac of the cyst consists of a greatly dilated common duct, the only rational treatment is primary choledocho-enterostomy. Waller reported one case and collected thirty-four. Thirty of these cases were operated upon: in twenty-one the cysts were sutured to the abdominal wound and fistulæ established; they all died after longer or shorter intervals. In three cases the sacs were extirpated; these three died. Upon the five cases that recovered anastomosis between the common duct and the small bowel had been performed. A. A. McConnell (British Journal of Surgery, 1920, vii, p. 520) reported one case of cyst of the common bile-duct, recommended anastomosis between the cyst wall and duodenum or jejunum and stated that both drainage and extirpation were improper procedures. He said that this condition should be called "diverticulum" of the common bile-duct.

Santoni in 1894 detected, by auscultatory percussion, a peculiar, low booming which lasted but a brief time and stopped abruptly, and has been considered pathognomonic of hydatid disease (Deaver and Ashhurst, Surgery of the Upper Abdomen, 2nd Ed., 1921). Of course, both Santoni's sign and hydatid thrill will be absent from non-parasitic cysts.

For several years the reliability of hydatid thrill as a diagnostic sign of echinococcus cyst has been questioned by certain writers. Over twenty-five years ago Huber (Twentieth Century Practice, vol. viii, 1896, p. 520) wrote that he failed to observe the thrill in over one-half of his cases and quoted Bamberger as declaring "the manifestation worthless and as only a fluctuation sign which is even more frequent in ascites and ovarian cysts." Semmala and Gioffredi (Twentieth Century Practice, vol. ix, 1897, p. 452) thought that hydatid thrill was gradually losing its reputation as a valuable sign—citing Concato as having observed it in sterile cysts, and Caradelli (or Cardarelli?) as having noted it in hydronephrosis. Rolleston (Diseases of the Liver, etc.) wrote that the thrill could be obtained in sterile hydatid cysts,

in tense cysts of other kinds, such as hydronephrosis and sometimes in encysted ascites. Chauffard believed that hydatid thrill could occur "in general ascites under certain conditions, such as an elastic state of the abdominal walls in young persons" (Rolleston). Kehr said that it might be present in cystosarcoma of the liver (H. H. Haubold, The Principles and Practice of Surgery, 1921). Lancereaux (Rolleston) observed hydatid thrill twice only in sixty cases; Finsen (Haubold), not at all in 268 cases. G. M. Reykjavik, of Iceland (Archiv für klin. Chirurgie, B 100, Heft 2, cited by Barnett), wrote: "Hydatid fremitus is noted in a record of three out of 169 cases operated on, and the symptom is regarded owing to its rarity as of very little diagnostic significance."

On the other hand, F. Dévé (Les Kystes Hydatiques du Foie, 1905, cited by Barnett) had encountered hydatid fremitus six times in thirty-six cases and did not think that the tremor in other liquid swellings was quite the same as the true hydatid thrill. Dévé concluded that in practice we might consider the fremitus as pathognomonic of the existence of a hydatid cyst—at least, when it was produced quite clearly in the region of a protuberance from the liver. The most recent author on "hydatid thrill" seems to be L. E. Barnett, of New Zealand (New Zealand Medical Journal, October, 1921, vol. xx, p. 277), who has elicited hydatid thrill seven times in over three hundred cases. In each one of the cases in which the hydatid thrill had been demonstrated, the following conditions were found: the mother cyst was close to the abdominal wall; the cyst's walls showed signs of degeneration "leading to a slackening of the high normal tension that exists within the usual hydatid cyst." A few large daughter cysts were present, not closely packed together, but having room to vibrate in contact with the walls of the mother cyst. Barnett's illustrations are drawn to show that; in a single tense cyst there is no thrill; in a single slack cyst there is a "wavy fluctuation" but no thrill; in a cyst containing daughter cysts, tightly packed together, there is no thrill; in a cyst with a few large daughter cysts, not tightly packed together but able to vibrate in contact with the walls of the parent cyst, there is hydatid thrill. Barnett states: "The distinctive feature of the true hydatid thrill is the exquisite spring-like vibration which is quite distinctly prolonged beyond the moment of percussion, and which is associated with the remarkable drum-like resonance heard on auscultatory percussion." Barnett adds that hydatid fremitus of this character is the only form pathognomonic of hydatid cysts. According to Huber, hydatid thrill (Fremissement hydatique) was pointed out in 1801 by Blatin and first clearly described in 1828 by Briancon.

The various laboratory tests for hydatid disease ought to be negative in cases of non-parasitic cyst of the liver. The miostagmin, Abderhalden and intradermic reactions, the complement-fixation and precipitin reaction tests, as well as a cutaneous test for hydatid disease have been described recently by T. B. Magath (The Medical Clinics of North America, September, 1921, vol. v, No. 2, p. 563). While the complement-fixation test was nega-

tive in one of Rosenstein's cases and in Munk's case, it was positive in Tuffier's case. Kilvington (Medical Journal of Australia, December 17, 1921) found the complement-fixation test "absolutely accurate" in his cases of hydatid disease.

Diagnosis of non-parasitic cysts of the liver has seldom been made before operation or before necropsy. From the reported cases it would seem that non-parasitic cysts seldom become large enough to cause manifestations during life. On the few occasions on which they have caused local signs, the latter have been the signs of a growing abdominal tumor either obviously hepatic and usually considered echinococcic, or not apparently connected with the liver and adjudged ovarian, hydronephrotic or some other cystic condition. The X-rays may show, as in Dujarrier's case, that the tumor is part of the liver shadow.

Jaugeas (Archives of the Röntgen-ray, vol. xviii, June, 1913, to May, 1914, p. 48) tells us that in one of Béclère's cases the radioscopic examination revealed a nodosity in the upper anterior part of the liver. A diagnosis of hydatid cyst was made. The supposed cyst was punctured without result and a subsequent laparotomy disclosed a solid, syphilitic tumor. Where it is uncertain whether the tumor be connected with the liver or not, radioscopic examination may show the relations of the cyst to the liver shadow, or, on the contrary, by showing a normal hepatic shadow, demonstrate that the tumor has nothing to do with the liver (Jaugeas). "In other cases, where the clinical examination had led to a suspicion of hepatic disease, the screen examination may demonstrate the existence of a purulent pleurisy instead of a liver abscess or a pulmonary tumor in lieu of a hydatid cyst" (Jaugeas). Béclère, Cottenot and Laborde (Radiologie et Radium therapie, being vol. xxxii of Traité de Pathologie Médicale et de Thérapeutique appliquée, edited by Sergent, Ribadeau-Dumas and Babonneix, Paris, 1921, p. 213) teach, among other things, that the hydatid cyst can develop entirely in the parenchyma and show no irregularity of the hepatic borders. Usually, it shows no difference in opacity from the neighboring liver tissue and is missed at examination. Exceptionally, these authors state, one can distinguish "a regularly rounded zone which is a trifle more opaque." R. Kienböck (Fortschr. a. d. Geb. d. Roentgenstrahl, Hamburg, 1913, xxi, p. 77, cited by Barker in Monographic Medicine, 1916, vol. iii, p. 650) reported a case of hydatid cyst of the liver in which the diagnosis was made by X-ray examination. Recently, Fritz Partsch (Deutsch. med. Wochenschrift, August, 1921, abst. International Medical and Surgical Survey) has reported that, by means of Rautenberg's pneumoperitoneal method, he had made the correct diagnosis in seven cases of echinococcus of the liver.

In the sixty-one cases of non-parasitic cysts, a list of which is appended to this report, "hydatid cyst" and "ovarian cyst" have been the diagnoses most frequently made. Leppmann's diagnosis was "cystic tumor of the liver, probably hydatid," and he also considered right-sided hydronephrosis and mesenteric cyst; von Haberer thought that he was dealing with a pan-

creatic cyst or with tuberculous peritonitis; Bland Sutton's case clinically resembled mesenteric cyst; Corner's case suggested distention of the gall-bladder; Soto believed that he had a case of suppurative cholecystitis; before operation, Orloff considered primary carcinoma, hydatid cyst and cystic degeneration; Fritz Munk's diagnosis was "a sessile tumor of the liver, having nothing to do with the gall-bladder"; Fieschi, before operation, made a diagnosis of "simple cyst of the liver with chronic angiocholitis"; Grigaryeff, because he had observed another similar case, made a diagnosis of "probable cystadenoma."

Seldom have accidents been recorded in connection with non-parasitic cysts of the liver. Kilvington (Intercolonial Medical Journal of Australasia, 1902, vol. vii) cites Allen's case of a young woman who suddenly collapsed and died after symptoms "like those of rupture of a large internal aneurism." Necropsy showed that the liver was the site of a non-parasitic cyst which was filled with blood from one of the large dilated blood-vessels in the cyst-wall.

Infection of these non-parasitic cysts of the liver has not often been recorded. C. Murchison (Clinical Lectures on Diseases of the Liver, etc., 3rd ed., edited by T. Lauder Brunton, 1885, cited by Fieschi) reported a case of non-parasitic cyst of the liver which had suppurated and opened into the peritoneal cavity, causing death. Bouilly (Bulletins de la Societé Anatomique de Paris, 1874, vol. xvii, reported 1872, cited by Tuffier) held a post-mortem on a case of suppuration in a non-parasitic cyst of the liver. The cause was not known.

About twenty-five years ago H. J. Waring (Diseases of the Liver, Gall-bladder, etc., 1897, p. 137), speaking of hydatid and non-parasitic cysts of the liver, said: "The treatment of both varieties of cyst is, however, similar and a mistake in the diagnosis is not of much importance."

Usually, in the case of a hydatid cyst, after removal of the endocyst, it has not been deemed prudent to attempt to detach the adventitious sac or ectocyst from the liver because of the danger of fatal hemorrhage; but the operator has stitched the open ectocyst to the abdominal incision, making a pouch of (or marsupializing) the sac. The interior of the cyst has been disinfected by a chemical either before (Quenu) or after cutting into the ectocyst. Often a drainage tube has been inserted into the marsupialized ectocyst. Less frequently, after evacuation of the endocyst and disinfection and drying of the interior of the ectocyst, the incision in the latter has been sutured and the abdomen closed without drainage. Closure without drainage seems to have grown in popularity in Australia (Kilvington, Med. Journ. of Australia, December 17, 1921; W. J. S. McKay, Med. Jour. of Australia, January 3, 1920). Occasionally, not often, the adventitious capsule has been firm enough to permit of complete excision of the hydatid cyst. Recently, C. E. Corlette (Med. Jour. of Australia, December 17, 1921) extirpated from the liver two partially calcified hydatid cysts. In the appended collection of non-parasitic cysts of the liver, because of difficulty of approach,

because of hemorrhage, because of the thinness of the capsule, because of the general condition of the patient or because of some other sound surgical reason, there have been more instances of marsupialization than of extirpation. Where hardening of the liver at the base of the cyst has been such as to permit of the passage of sutures (as in the case now reported), where there has been a firm, strong capsule, where it has been apparent from the beginning of the dissection that the cyst would separate with a reasonable amount of hemorrhage and where the cyst has had a definite pedicle, complete removal has been possible. McKay's method of handling the adventitious sac of a hydatid cyst could be used in the treatment of certain types of non-parasitic cysts. After he has removed the endocyst, disinfected and dried the interior of the ectocyst, he sutures the ectocyst to the abdominal incision, the catgut passing through the peritoneum, muscles and aponeurosis but not through skin. Then he closes the abdominal wall over the opening of the attached sac. If anything goes awry, a drainage tube may be inserted into the cyst by removing a few of the skin sutures. I think that most surgeons believe that the outer capsule of a hydatid cyst should be sutured to the abdominal wall—whether the latter be closed afterwards or not. McKay makes a commendable attempt to prevent the sinus which may last for months or even years after marsupialization of either a hydatid or a non-parasitic cyst. Of course, it would be necessary, in the case of the non-parasitic cyst, to destroy the secreting lining—preferably by means of a chemical, as a curette might start hemorrhage. In dealing with a non-parasitic cyst of the liver, if neither extirpation nor marsupialization be deemed desirable in a given case, the cyst-wall may be anastomosed to the duodenum (see Burghard's case).

In the appended sixty-one cases trauma has appeared in the history in four cases. In the celebrated case of Alban Doran the history of a blow on the right hypochondrium nearly three years before jaundice began, suggested to Doran that the blow might have ruptured a bile-duct and caused very slow extravasation of bile into bruised liver substance, thus forming a cystic cavity. In Guerkin's case the patient, about four years before his first operation, injured the region of his liver, by falling on a fence. In the case reported by Lisyanski and Lyudkevich the patient noticed heaviness in the right half of her abdomen several years before her operation, and two months before her operation suffered a slight sprain of the right side of her back "in the region of the waist-line." Soto's patient had a tumor in the liver region for several years and then she struck it while bathing. While it is theoretically possible for an injury to rupture a bile-duct or to cause hemorrhage into the liver, which may be followed by a pseudo-cyst, I do not believe such traumatic genesis can be proved.

In the appended list of reported cases I have not included the cyst removed by W. J. Mayo, and reported by M. S. Henderson (ANNALS OF SURGERY, 1909, vol. l, p. 550), because at operation it was noted "that the

cyst had its origin in the lower two inches of the round ligament of the liver, etc."

Through the kindness of Dr. W. J. Mayo and Dr. Stuart W. Harrington, I am permitted to quote statistics on non-parasitic cysts encountered in the Mayo Clinic. The following is from Doctor Harrington's letter of July 18, 1922:

"I find that in all we have 25 cases of single cysts of the liver, and 10 cases of multiple cysts of the liver. Of the single cysts the great majority were found during operations for other conditions—mostly for diseases of the gall-bladder. In the 25 cases, 14 were found during an operative procedure on the gall-bladder itself where a diagnosis of cholecystitis had been made and the pathology found in the gall-bladder; 5 were found during operations for ulcer, 3 at operations for carcinoma of the stomach, and 3 were found when we operated for tumor or cyst of the liver. The last three cases were all very large cysts which were palpated in the abdomen in the right lobe of the liver, beginning just outside the gall-bladder. One contained about 5 litres of milky fluid; the other two contained clear fluid.

"In the great majority of these cases, the cyst was located about the gall-bladder fossa, usually to the right of the gall-bladder, extending behind the cystic duct, at times causing pressure on the cystic duct. They varied in size from one inch in diameter to six or eight inches in diameter. One patient was twenty-five years of age, one was twenty-four years, seven were in the fifties, eight in the sixties, five in the forties, two in the thirties, and one in the seventies. There were eight males and seventeen females. All of these cysts were examined by the pathologists and found to be simple. There was no mortality at operation.

"There were only ten cases of multiple cysts of the liver, eight of which were in females and two in males. One patient was thirty years of age, four were in the fourth decade, two in the fifth, and three in the sixth. In this group the cysts ranged in size from the size of a pea to that of an orange, and there was considerable cystic disease of the entire liver. Two cases were associated with chronic cystic disease of the kidneys. Most of the cysts contained clear fluid, but in some the fluid was bile stained. There was no definite symptomatology for this group. Five cases were operated upon for abdominal tumor—probably cyst of the liver, two for cholecystitis with stones, one for duodenal ulcer, and two ovarian and uterine fibroids."

A LIST OF REPORTED NON-PARASITIC LIVER CYSTS OPERATED UPON SURGICALLY

This list is confined to brief reports of cases which have undergone surgical operations, containing résumés of cases of non-parasitic cysts, asserted or proved, and of non-parasitic cystic formations or degenerations. The compiler of this list has used Sidney Boyd's collection of thirty-four cases which includes eighteen cases collected by C. Hofmann and three cases collected by A. Doran. P. S. Ikonnikoff's collection of twenty-one cases is

also contained in Boyd's list. The writer has added twenty-six cases to Boyd's thirty-four and has supplied one case, making a total of sixty-one. The article by Lisyanski and Lyudkevich and the one by Ikonnikoff have been abstracted in English by Dr. R. Vera Zabarkes. The report of a chemical analysis by Steensma, the case reports by Grigoryeff and by Guerken, as well as the two case reports by Rosenstein, have been translated into English by The American Institute of Medicine. In each of the following cases the diagnosis may be considered positive or probable according to whether or not the cyst-wall has been examined microscopically. Where the operator is not the reporter of the case, the operator's name appears first and the name of him who reports or cites the case appears second, in parenthesis. Usually, but not invariably, information concerning each case is limited to the following notes: Operator; by whom, when and where reported; sex and age of patient; anatomical location of cyst; contents of cyst; method of operation; report of pathologist; result of operation.

1. Gloz, 1864 (Inaugural-Dissertation, Tübingen, 1864, cited by Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Male, twenty-eight. Lower and anterior surface of right lobe. Six litres from two tappings. Greenish-yellow, clear fluid containing albumen. Multiple punctures. Death from suppuration after third puncture. This was before the inauguration of antisepsis. (It is quite possible that Bruns operated on this case; I have not been able to consult the original report).

2. W. Cousins, 1874 (British Medical Journal, 1874, vol. ii, p. 700). Female, twenty-seven. Lower surface. Two and one-half gallons of clear, limpid, yellow fluid. Resected and stump fixed to wall of abdomen. Died in thirty-six hours from peritonitis. C. Langenbuch (Chirurgie der Leber und Gallenblase, 1897, Part ii, p. 23) speaks of this case as follows: "The inner surface of the cyst was rough and considered in course of degeneration, but to what variety this cyst belonged and if it might not have been a question, perhaps, of an acephalic echinococcus—is not quite clear from the publication." Doran. (Trans. Royal Med. and Chirurg. Soc., 1904), however, says that when Goodhart mounted this cyst as a specimen in the museum of the College of Surgeons (Path. Series 2758), he could find no hydatid elements in it.

3. Alfred North, 1882 (Medical Record), New York, September 16, 1882, vol. xxii, p. 344). Male, forty-five. Left lobe. Five pints of coffee-colored fluid containing bile and albumen. Cyst size of man's head. Puncture. Died two days later; peritonitis. Stones in gall-bladder and in common duct. No signs of hydatid in the cyst. Post-mortem. Right kidney cystic.

4. Kaltenbach, 1885 (Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Female, age not given. Lower surface. Large multilocular tumor from which 320 litres of viscid, greenish-brown fluid were obtained by several punctures. Microscopic examination of contents gave negative results. Entire cyst extirpated. After tightening an elastic ligature around the base "a hand's breadth of liver lobe" was removed. Hemorrhage controlled by sutures. Recovered. Kaltenbach writes to Winckler, about 1890: "The woman is now, after five years, still well except for diabetes." Lœppmann (l.c.) remarks that this was an extremely large multilocular cyst, adherent to the liver, but its origin could not be fully established.

5. König, 1886 (Hüter, Inaugural-Dissertation, Göttingen, 1887). Female, eleven. Right lobe. Cyst contained brownish-gray fluid. Extirpated. Numerous large and small cysts lined with cylindrical epithelium. Cyst-adenoma of bile-ducts. Recovered.

6. Louis McLane Tiffany, 1890 (Reported June 6, 1890, at the 236th meeting of the Clinical Society of Maryland, Maryland Med. Jour., Baltimore, October 18, 1890, vol. xxiii, No. 25, p. 531. Also International Medical Magazine, 1892, vol. i, No. 3, p. 235). Male, twenty-five. Convex surface of the liver. Nodule size of a walnut "Composed of liver tissue in which there was much exudation, while scattered through the growth were many fine grains of sand—no doubt, minute calculi." Tumor excised by means of curved scissors and wound in liver cauterized. Recovered. Diagnosis not made. According to W. W. Keen, this is the first recorded case of liver resection in America.

7. Ahlfeld, 1890 (Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Female, thirty-eight. Lower surface. Eight litres of slimy, yellow fluid, containing albumen. Incision and drainage. A piece of the cyst-wall was excised for study. On the inner surface of the cyst-wall neither epithelium nor glands could be detected. Recovered. Still had a fistula several weeks after operation.

8. W. Müller, 1891 (Verhandlungen der deutschen Gesellschaft für Chirurgie, 1893). Female, fifty-nine. Lower surface. Six litres of chocolate-colored fluid. Two-thirds of cyst-wall excised and remainder sutured to abdominal wound. Large and small cysts lined with epithelium. Cystadenoma. Recovered. Re-examination six years after operation (Verhandlungen der deutschen Gesellschaft für Chirurgie, 1897, vol. i, p. 137) and patient in good condition.

9. Terillon, 1891 (Bulletin et Mémoires de la Société de Chirurgie, 1891). Male, fifty-two. Intrahepatic. Two litres of biliary fluid. Puncture. Died three months later. Carcinoma of liver and gall-bladder. Dilatation of bile-ducts. Probably a retention cyst.

10. W. W. Keen, 1892 (Boston Med. and Surg. Journal, 1892, vol. cxxvi, p. 405). Female, thirty-four. Thermo-cautery and enucleation. Four very large vessels tied with catgut. Edges of liver wound united by fine silk. Stump returned to abdomen. Abdominal wound closed after inserting a glass drainage tube which was removed after 48 hours. Stitches removed at the end of a week. Diagnosis: Cystic adenoma of the bile-ducts weighing 113 grams (3½ ounces). Size: 9 by 11½ cms. and 4½ cms. thick at base. Well eight years later. (Annals of Surgery, 1899, vol. xxx, p. 267).

11. Bayer, 1892 (Prager Medicinische Wochenschrift, 1892, No. 52). Female, fifty-six. Filled entire liver. Eight litres of brownish-gray fluid. Incision and drainage. Dilated bile-ducts; atrophy of liver tissue; thick interstitial tissue; cyst-wall two to four mm. thick. Slowly recovered.

12. A. W. Mayo Robson, 1892 (On Gall-stones and Their Treatment, 1892, Case 28). Female, forty-two. Right lobe. Six ounces of clear, straw-colored fluid. Opened by cautery. Cholecystostomy for gall-stones. Operative recovery. Died several weeks after operation from broncho-pneumonia.

13. Körte, 1893 (C. Langenbuch, Chirurgie der Leber und Gallenblase, Deutsche Chirurgie, Lief. 45 C., Bd. i und ii, Stuttgart, 1894 und 1897). Sex not given. Age, forty-five. Margin of liver. Serous fluid. Cysts the size of eggs. Incision and drainage. Recovered.

14. Berg, 1894 (Hygieia, Band IV, 1894). Female, forty-five. Anterior border of left lobe. Resection. Recovered.

15. John B. Roberts, 1894 (Annals of Surgery, February, 1894, vol. xix, p. 251; The American Journal of the Medical Sciences, December, 1894, and elsewhere). Female, fifty-six. Great enlargement of the liver. Cysts intrahepatic. Operation in two stages; first, stitched the prominent of several cysts to parietal peritoneum; second, seven days later, laid open adherent cyst and through it the other cysts. Fluid clear and limpid, contained albumen and was negative for hydatid elements. Died three weeks after operation of pleuro-pneumonia,

etc. Diagnosis, cystic adenoma. Both kidneys cystic. Liver weighed eleven and one-half pounds.

16. W. Müller, 1897 (Verhandlungen der deutschen Gesellschaft für Chirurgie, 1897, vol. i, p. 137). Female. Right lobe. Clear serous fluid. Resection of large wedge of liver left a space communicating with numerous small cysts. Cystic adenoma. Died eleven days after operation from pulmonary embolism. Similar cystic degeneration of kidneys.

17. Schmidt, 1897 (H. J. Waring, "Diseases of the Liver," etc., 1897, p. 154). Female, sixty. Location and contents of cyst not stated. He removed from the liver a small tumor which contained a number of cysts. Thought to be cystic adenoma. Recovered. No recurrence. Well six years after operation.

18. Chobak, 1898 (Wiener klinische Wochenschrift, 1898, No. 14). Female, forty-six. Right lobe. Half a litre of yellowish-green fluid containing albumen. No sugar. No signs of hydatid elements. No succinic acid. Multiple cysts. Two-stage operation. Incision and drainage. Recovered. Well five months after operation.

19. Czerny, 1898 (Petersen, Verhandlungen der deutschen Gesellschaft für Chirurgie, 1898). Sex and age not given. Part of liver involved not stated. Cyst of the bile-ducts. Resected. Recovered.

20. A. A. Bobroff, 1898 (Khirurgia, 1898, vol. iv, p. 36, and Centralblatt für Chirurgie, 1899, No. 10). Female, fifty-one. Lower surface. Part of cyst-wall excised and the remainder sutured to the abdominal wall. Cavity of the cyst lined with epithelium. Adenocystoma. Recovered.

21. Porter, 1900 (Shattuck, Boston Medical and Surgical Journal, 1900, p. 427), Female, sixty-three. Top of liver near falciform ligament. One gallon of clear, colorless fluid. Incision and drainage. Small cysts and bile-ducts in wall of cyst. Cystic-adenoma. Died several months later following an operation performed to cure the chronic sinus.

22. Robert Schultze, 1900 (F. Leppmann, Deutsche Zeitschrift für Chirurgie, 1900, vol. liv, p. 446). Female, fourteen. Lower surface. Two-stage operation: August 3, 1898, cyst drawn out and sutured to abdominal wall; August 7, 1898, sac resected and drained. Cyst, size of child's head, contained about 1500 c.c. of a brownish fluid. Much mucus and albumen present. Succinic acid and sugar absent. No evidence of microscopic constituents of hydatid. Cyst wall consisted of three layers of connective tissue lined by tall columnar epithelium. Recovered, but fistula remained.

23. C. Hofmann, 1902 (Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie, 1902). Female, twenty-eight. Quadrate lobe. Yellowish-gray fluid containing albumen. Excision of entire cyst. Cyst-wall had three layers of connective tissue paved with cuboidal epithelium. Cystadenoma. Recovered.

24. F. Bird, 1902 (Basil Kilvington, Intercolonial Medical Journal of Australasia, Melbourne, December 20, 1902, vol. vii, No. 12, p. 557). Sex and age not given. Location in liver not stated. Contents of cyst not described. The cyst was opened, its walls sutured to the abdominal incision and the cavity drained. Patient recovered. Two years after operation, a similar but smaller tumor was detected in the liver. "This is probably an adjacent cyst enlarging, or possibly the old one refilling." Pathological report: Simple cyst.

25. A. Doran, 1903 (Transactions of the Royal Medical and Chirurgical Society, 1904, and British Medical Journal, 1903, vol. ii), Female, forty-two. History of trauma to hepatic region. Right lobe. Forty-eight ounces of pure, deep green bile withdrawn from cyst. Operation: incision and drainage. Recovered. Sinus which closed in nine months. Patient in good condition six months afterwards. (British Medical Journal, 1905, vol. ii.)

26. W. N. Orloff, 1903 (L. A. Diwawin, Russ. Med. Rundschau, Berlin, 1904, vol. ix, p. 534. Also Khirurgia, Mosk., 1903, vol. xiii, p. 433). Female, forty-five. Right and left lobes were overrun by several large cysts, varying in size from a grain of juniper to a hen's egg. Puncture of the cysts showed them to contain serous fluid. A part of the cyst-wall was removed for examination and pronounced cystadenoma. An umbilical hernia was cured at the same operation. Recovered from operation and after nine months was able to attend to her work.

27. G. B. Miller, 1903 (American Journal of Obstetrics, vol. xlviii, August, 1903, p. 182). Female, two and one-half years. Miller reported the case as a congenital dilatation of the gall-bladder and bile-ducts but Doran believed it to be an intrahepatic cyst. The tumor occupied part of the liver, the round ligament and the suspensory ligament being attached to its upper surface. "The liver was largely replaced by the tumor." This liver substance represented the right lobe. It contained five pints of bile. Two-stage operation; opened by means of cautery. Recovered.

28. Morton, 1903 (The Lancet, November 14, 1903, p. 1395). Female, sixty-three. Right lobe. Straw-colored fluid containing albumen; no sugar. Incision and drainage. Recovered.

29. A. A. Bobroff, 1904 (L. A. Diwawin, Russ. Med. Rundschau, Berlin, 1904, vol. ix, p. 534). Male, thirty-nine. Left lobe of liver swollen to size of a child's head. Laparotomy and puncture of cyst. Three hundred cubic centimetres of a clear, light-yellowish fluid, containing 5 per cent. albumen, no sugar, no succinic acid and no hydatid elements. Abdomen closed with exception of gauze left in upper corner of wound to promote adhesions between liver and abdominal wall. Recovered from operation and was discharged from hospital one month after operation. Condition good for three months. Died five months after operation. For several days preceding death there were chills.

30. C. B. Blackburn, 1904 (Transactions of the Pathological Society of London, vol. lv, p. 203). Female, forty-nine. Upper surface of liver studded with small cysts, from the size of a grape to a split pea; on right lobe there was one larger one—about the size of a tennis ball. This was aspirated and contained no sign of hydatid membrane. The cyst fluid was straw-colored, had a trace of albumen and no sugar. No hooklets or other microscopic evidence of hydatid could be detected. Left kidney was cystic also. Recovered. In good condition three years afterwards.

31. J. A. Reid, 1904 (C. B. Blackburn, Transactions of the Pathological Society of London, vol. lv, p. 216). Also Intercolonial Medical Journal, vol. i, p. 90). Male, sixty-two. Liver riddled with cysts of various sizes up to the largest one (size of a fœtal head) which was opened and drained, bile-stained fluid for several days. Kidneys also cystic. Microscopically, after death in the larger liver cysts no definite epithelial lining could be made out, but in the smaller ones it was usually evident, the cells varying from flat to cubical or even columnar in type. In the cyst fluid was no evidence of hydatid; no scolices; no hooklets. Died on seventh day of uræmia.

32. Bland-Sutton, 1905 (British Medical Journal, 1905, vol. ii. Also Centralblatt für Chirurgie, 1906, vol. ix). Female, seventy-five. Left lobe. Two pints of brown fluid; no sugar. Cyst completely shelled out. Cyst-wall consisted of fibrous tissue lined with flat epithelium. Recovered.

33. S. P. Theodoroff, 1906 (P. S. Ikonnikoff, Russkiy Vrach., Saint Petersburg, 1906, vol. v, p. 1181. Cited by von Haberer, 1909, Sidney Boyd, 1913, and translated into English for this article by Dr. R. Vera Zabarkes). Female, forty-four. Right lobe. Cyst as large as a child's head. Part of cyst-wall excised and

remainder fixed to abdominal wall. Pathological report. Cystic adenoma of bile-ducts. Recovered. Had fistula twenty-seven months after operation.

34. D. Fieschi, 1909 (La Clinica Chirurgica, Milan, August 31, 1909, vol. xvii, p. 1457). Female, fifty-two. Liver extended to right iliac fossa and was covered with many transparent cysts varying in size from a grain of corn to a three-leaved clover. The cysts contained mucus slightly stained by bile. Gall-bladder enlarged and stone in cystic duct. In order to perform cholecystostomy an overhanging Riedel's lobe was excised. Microscopically, these cysts were lined with one, two or even three layers of epithelium. No evidences of hydatid elements. Post-operative diagnosis: Calculus of the cystic duct with partial obstruction; acute suppurative cholecystitis in a cirrhotic liver, hypertrophied and polycystic from mucous bile cysts; diffuse low-grade angiocholitis. Recovered, but fistula continued after two years.

35. Hans von Haberer, 1909 (Wiener klinische Wochenschrift, 1909, vol. xxii, p. 1788). Female, thirty-four. The whole left lobe was the site of a cyst the size of a child's head. Clear, light-yellow fluid containing albumen. Hepatic artery ligated and entire left lobe of liver removed. The large cyst as well as several small ones lined by epithelium. Cystic adenoma of the bil-ducts. Abdomen closed without drainage. Healing by first intention and patient left hospital fourteen days after operation.

36. Shaw and Elting, 1909 (Archives of Pediatrics, New York, 1909, vol. xxvi, p. 818). Female, one year and one-half. Right lobe. Nine hundred c.c. clear, yellow fluid; albumen. Incision and drainage. No epithelium could be detected in cyst-wall. Died from shock. Kidneys normal.

37. H. Küttner, 1911 (H. Coenen, Berl. klin. Wochenschrift, 1911, p. 153). Male, fifty. Liver completely overrun with cysts of various sizes—the largest being the size of a goose egg. They contained a serous, opal fluid. Kidneys seemed normal. A few of the smaller cysts were excised for examination. They were lined with epithelium. Abdomen closed. Recovered and left hospital sixteen days after operation.

38. G. F. Aldous, 1911 (British Medical Journal, 1911, vol. ii, p. 688, September 23, 1911). Female, forty-three. "The swelling proved to be a solitary hepatic cyst occurring at the free border of the liver." Gall-bladder normal. Twelve pints of thin, dark, muddy fluid. Cyst-wall stitched to parietal peritoneum and drained. Recovered.

39. Corner, 1912 (The Medical Press and Circular, February 7, 1912, N. S., vol. xciii, p. 142). Female, "in the latter half of middle age." Right lobe. Cyst was about four inches in diameter and contained a slightly opalescent fluid. Cut through liver and removed cyst entire and unopened. Gall-bladder normal. Pathological examination showed no indication of hydatid. Recovered.

40. W. T. Reynolds, 1912 (The Medical Herald, St. Joseph, April, 1912, N. S., vol. xxxi, p. 168). Female, fifty. Left lobe. Two pints of clear, straw-colored fluid. Entire cyst-wall dissected out and liver surfaces brought together with mattress sutures. Two stones removed from gall-bladder by cholecystostomy. Microscopic examination of cyst-wall: "One portion of the cyst-wall showed two hairs growing out and sections in this vicinity reveal the presence of stratified squamous epithelium, such as is found in the skin. The outer layer is cornified. One portion of these sections shows what appears to be a hair follicle." "Certain parts of cyst-wall undoubtedly contain teratoid tissue which makes it evident that this tumor belongs to the teratoid group." Recovered. Left hospital at end of two weeks.

41. Tuffier, 1912 (Bull. et mém. Soc. de chir. de Paris, October 30, 1912, vol. xxxviii, p. 1252). Male, twenty-three. Right lobe. Cystic mass completely extirpated and hemorrhage from its bed in concave surface of liver controlled by

catgut sutures. Kidneys normal. Abdominal wall sutured with sub-hepatic drainage for forty-eight hours, when flow of a little blood and bile stopped. In excised tumor there were many cysts, completely isolated and containing different kinds of fluid, but all lined with epithelium. No hooklets or other signs of hydatid, although Parvu's complement-fixation test had been positive. Pathological diagnosis by Maute: Non-parasitic cyst of liver developed probably at the expense of the intrahepatic bile-ducts. Recovery uneventful and patient well when seen several months after operation.

42. Fritz Munk, 1912 (Berl. klin. Wochenschrift, 1912, vol. xlix, p. 2174). Female, forty-four. Left lobe. Somewhat thick-walled cyst, the size of a child's head. Two-stage operation: First, parietal peritoneum fixed to liver around part to be tapped; second, forty-eight hours later, cyst punctured and 300 to 400 c.c. of a greenish-gray, somewhat tenacious, slightly turbid fluid evacuated. The contents had no formed elements except blood and remained sterile on agar-plates. Four days after operation sac became infected by colon bacillus which delayed recovery. Finally, wound healed and patient was discharged. This case had been negative to the Weinberg and Ghedini's complement-fixation test with hydatid fluid. Two years after operation patient entirely free from symptoms.

43. F. A. Steensma, 1912 (Nederl. Tijdscher. v. Geneesk., Amst., 1912, vol. ii, p. 1209). Steensma made a chemical analysis of the contents of a simple hepatic cyst. Name of operator, method of operation and part of liver involved are not stated. Steensma says: "Solitary hepatic cysts are very rare. A comprehensive research upon the contents of such cysts has not been as yet undertaken. I had the opportunity of making one such research. At the operation, six litres of fluid were removed from the cyst. The fluid was thick and dark-brown in color."

44. Sidney Boyd, 1913 (The Lancet, April 5, 1913, vol. i, p. 951). Female, twenty-seven. Right lobe. Four pints of clear, mucoid, dark-green fluid, containing albumen. No sugar; no hooklets; no scolices. Incision and drainage. Operative recovery, but patient died three months after operation as the result of an unfortunate accident. The cavity had been irrigated for several weeks with a weak solution of hydrogen peroxide. On January 11, 1912 (operation had been October 9, 1911), while cavity was being irrigated, patient complained of severe pain and a little hemorrhage took place from sinus. Peritonitis followed at once and, in spite of laparotomy, patient died. Boyd thinks that the pressure, caused by the escaping gas from the hydrogen peroxide, either ruptured the sinus or tore it from the abdominal wall. Post-mortem was not allowed.

45. Henry Norris, 1913 (Annals of Surgery, June, 1913, vol. lvii, No. 6, p. 805, and Trans. South. Surg. and Gynæc. Association, 1912–1913, vol. xxv, p. 410). Female, fifty-one. Left lobe. Cyst the size of a small orange. Over 200 c.c. of almost clear fluid. Incision and drainage. Cyst-wall sutured to parietal peritoneum. None of cyst-wall excised but examination of fluid entirely negative. Recovered. Drainage tract entirely closed in four weeks.

46. S. G. Grigoryeff, 1913 (Vrach. Gaz., St. Petersburg, 1913, vol. xx, p. 1368, p. 1408). Female, fifty-six. Right lobe. Cyst the size of a baby's head, containing transparent fluid. Part of cyst-wall removed and remaining portion fixed to the wound. A drainage tube inserted. Microscopic examination of cyst-wall: Cystadenoma of the liver. Recovered. Fistula for six months.

47. N. A. Guerken, 1913 (V. N. Parin, Khirurg. Arkh. Velyaminova—Weliaminoff's Archives of Surgery—St. Petersburg, 1913, vol. xxix, p. 613). Male, twenty-two. Fistula in epigastric region, for over eight years, following operation for cyst of liver at another hospital. Fistula discharged 90 to 130 c.c. per hour of a fluid containing 4 per cent. albumen, no sugar, no ferments and muco-pus. When ten years of age patient injured region of the liver by falling on a fence. The operation by Guerken was performed April 22, 1911. Cyst separated from

liver by blunt dissection and hemorrhage arrested by ligature and gauze pressure. Abdomen sutured in layers. Cyst weighed 472 grams and measured 12 x 9 x 8 cm. Grayish-white in color. Microscopic examination: lined with columnar epithelium; diagnosis, cystadenoma of liver. Patient died of shock a few hours after operation.

48. V. I. Lisyanski and Anna P. Lyudkevich, 1913 (Russkiy Vrach., St. Petersburg, 1913, vol. xii, p. 18; translated into English for this article by Dr. R. Vera Zebarkes). Female, twenty-nine. Authors do not state exact part of liver whence cyst arose, but encountered "an enormous cyst of the liver, the size of a large watermelon." Cyst punctured; it contained blood. Portion of cyst-wall excised and remainder sutured to abdominal wound and drained. Microscopically, cyst contents were cellular elements of blood very little altered. Cyst-wall was composed of connective tissue, atypical liver cells and lumps of fibrin. No epithelial or endothelial cells could be detected. Authors believe that if they had been able to examine parts of cyst-wall more adjacent to the liver, they might have found small channels lined with epithelium. They also discuss possibility of pseudo-cyst from hemorrhage into the parenchyma similar to the condition which occurs in the spleen. (Reimann, Hedinger. B. K. Finkelstein.) Two months prior to her admission to the hospital patient sprained the right side of her back, but the sprain was not very severe. During first few days following operation the drainage tube discharged blood; then a yellowish fluid, apparently with traces of bile. Cavity of cyst became infected. Patient also had a transient nephritis. Fistula closed in seven months. Patient recovered completely.

49. Payr, 1913 (E. Sonntag, Beitr. z. klin. Chir., Tübing., 1913, vol. lxxxvi, p. 327). Female, twenty-five. Right lobe. Cyst the size of a small child's head. Contents not stated. Removed from liver by blunt and sharp dissection; a few ligatures used. Raw surface of liver sutured with catgut and packed with iodoform gauze, one end of which was left protruding through abdominal wound, which was sutured in layers. Three days later rubber tube substituted for the gauze. Profuse drainage of bile. Microscopically, lined with cuboidal epithelium. Pleuritis on eleventh day. On fifteenth day, 800 c.c. of serum aspirated from right pleural cavity. Rubber drain removed from abdomen in three weeks. Patient discharged from hospital in five weeks, wound being completely healed. Patient well after several months.

50. C. Dujarrier, 1914 (Bull. et mém. Soc. de Chir. de Paris, 1914, N. S., vol. xl, p. 444). Female, thirty-four. Cyst which has sprung from the convex surface of the liver at the level of the insertion of the suspensory ligament. Contains a clear liquid, slightly mucous. Cyst extirpated and hemorrhage controlled by catgut sutures and pressure. Abdomen closed in layers without drainage. Pathological examination of cyst: Measurements: 9 cm. high, 5 to 6 cm. broad, and a maximum thickness of 5 cm. Microscopically, the cyst-wall was composed of fibrous tissue parallel to the surface. There was no sign of epithelium, but there was an area of disintegration which did not take most of the stains. Patient recovered. Operation, February 26, 1914; stitches removed March 5, 1914; patient left hospital March 14, 1914.

51. D. L. Borden, 1914 (Virginia Medical Semi-monthly, Richmond, March 27, 1914, p. 609, 1913–1914, vol. xviii). Female, fifty. Right lobe. There was a large cyst extending between the diaphragm and the top of the liver. There were a few cysts on the anterior surface of the right lobe. The largest cyst was opened, evacuated, and its wall sutured to the parietal peritoneum. Cyst held about 3663 c.c. of a clear, slightly yellow fluid containing considerable albumen. There were no hooklets; no sugar; no succinic acid. Recovered. Fistula drained for five weeks and then closed.

52. F. F. Burghard, 1914 (J. Everidge, The Lancet, 1914, vol. i, p. 1748). Female, sixteen. Right lobe. Fifty-six ounces of a clear, greenish fluid were aspirated. Sac was anastomosed to the most mobile part of the duodenum and wound closed without drainage. Everidge assumes "that the cyst was a diverticulum of a bile-duct." Recovered and well five months after operation.

53. M. M. Rosenstein, 1914 (Khirurgia, Mosk., 1914, vol. xxxv, p. 52). Case I, male, forty-seven. Left lobe contained the largest cystic tumor which was totally excised. Entire liver was cystic as well as kidneys and pancreas. Drainage tube inserted under lower surface of liver and abdomen sutured. Excised tumor contained about three litres of transparent fluid. Seven per cent. albumen; no acids. Tumor was the size of a baby's head. The cysts were lined with epithelium. There were solitary cavities in the normal hepatic tissue lined with high columnar epithelium—like the epithelium of the gastro-intestinal tract of the human embryo. Patient recovered and left clinic after three weeks with wound entirely healed. The Weinberg complement-fixation test had been negative.

54. M. M. Rosenstein, 1914 (Khirurgia, Mosk., 1914, vol. xxxv, p. 52. Case II.) Female, thirty-seven. Right lobe, about one litre of turbid fluid evacuated from the cyst cavity. Inside of the cavity could be felt several smaller cysts. Part of the cyst with the adjoining portion of the margin of the liver dissected away and the remaining portion pulled forward and fixed to the wound. A drainage tube was inserted and left in place for twelve days. Microscopically, inner surface of cyst lined with columnar epithelium. Recovered and left clinic three weeks after operation.

55. L. S. Pilcher, 1915 (Year Book Pilcher Hospital, Brooklyn, 1915, p. 37). Male, seventy. Right lobe. "Two quarts of limpid straw-colored fluid escaped" after puncture. Empty cyst drawn through a counter-opening in the right lumbar wall, the greater part of the sac cut away and the remnant sutured into the lumbar opening. Drainage inserted in the lumbar opening. Anterior abdominal wound closed. Uncomplicated recovery.

56. John B. Deaver, 1918 (H. Lowenburg, Arch. Pediat., New York, 1918, vol. xxxv, p. 285). Male, nineteen months. "Tremendous cyst of liver." Dark, bloody fluid. Cyst incised; unilocular; wails one inch thick and did not bleed. A piece of cyst-wall excised and remainder stitched to abdominal wall; cavity packed with gauze. Pathological Report (Pfeiffer): Fluid contains neither parasites nor bacteria. Cyst-wall friable, brown in color and suggestive of a membranous lining; hemangioma of the liver. Child died a few days after operation from general asthenia.

57. Arthur Dean Bevan, 1919 (Surgical Clinics of Chicago, August, 1919, vol. iii, No. 4, p. 887). Female, fifty. Both right and left lobes. Large multilocular cyst. Several of the cysts punctured and fluid in all except one was clear; the fluid in this one was brown. One cyst removed for study and the others (on the surface) incised, evacuated and sutured. Kidneys, gall-bladder, pancreas, stomach and duodenum normal. Abdomen closed without drainage. Microscopic examination: Cystadenoma. Good operative recovery.

58. R. Soto, 1919 (Gaceta Medica de Caracas, Venezuela, October 15, 1919, vol. xxvi, No. 19, p. 201.) Female, forty-six. The cyst pedicle was implanted in the under surface of the liver, almost in the neighborhood of the common bile-duct. Gall-bladder normal. Twelve hundred grams of purulent liquid were aspirated. Marsupialization. The character of the cyst-wall and the absence of parasites of any description made Soto place it in the non-parasitic class. In May, 1913, patient had suffered a slight trauma to this region while taking a bath. Before operation the cyst had been punctured three times. Soto thinks that the punctures infected the cyst. Drain removed five days after operation. Sinus did not heal for three months, when patient was completely restored to health.

59. Arthur Evans, 1921 (British Journal of Surgery, Bristol, July, 1921, p. 155). Female, fifty-three. "A large cystic swelling was found attached to the under surface of the liver over an area of about six inches and passing back into the right paravertebral fossa." Sac resected and drained. Pathological examination (Braxton Hicks): "No scolices; no hooklets. Cyst lined with well-formed non-ciliated columnar epithelium; cystic adenoma of bile-ducts." Operation, December 1, 1919. Recovered, but sinus persisted.

60. David B. Allman, 1922 (Journal of the American Medical Association, May 20, 1922, vol. lxxviii, p. 1532). Female, sixty. Right lobe. Cyst about the size of a grape-fruit. About 600 c.c. of clear fluid aspirated. Carbolic acid applied to cyst-wall. Part of sac removed and remainder sutured around a rubber tube drain. Umbilical hernia repaired at same time. Neither sugar nor albumen in cyst fluid; no parasites; no ova; no hooklets. The fluid produced no growth in blood-agar or in plain bouillon. Uninterrupted recovery.

61. John F. X. Jones, 1921. Female, seventeen. Left lobe. Grayish-white cyst, 19 cms. long and 10 cms. in its greatest diameter, containing 990 c.c. of what appeared to be pure green bile. Cyst, together with anterior margin of left lobe, excised. Liver sutured with catgut. Gall-bladder normal. Abdomen closed in layers without drainage. Fluid centrifuged and examined for echinococcic hooklets; none found. Cultures of this fluid sterile after ten days' incubation. Cyst lined with a single layer of low cuboidal epithelium. Diagnosis: Retention cyst of liver (J. D. Paul and Allen J. Smith). Operation, May 13, 1921. Stitches removed May 21, 1921 (healing by first intention). Patient left hospital May 29, 1921, sixteen days after operation. Last examined July 21, 1922, over fourteen months following operation, and found in good condition with no recurrence.

COLLOID CARCINOMA

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There has been much uncertainty concerning the subject of colloid carcinoma. Many opposing views are held of its relative malignancy, the significance of its colloid, and the source of its origin.

Colloid carcinoma has many synonymous names: mucoid carcinoma, gelatinuous carcinoma, myxomatous carcinoma, carcinoma colloides, and so forth. Objection has been raised to the term *colloid cancer,* used by Virchow, because *colloid* is now used more specifically to mean the gelatinous substance containing iodin found only in the thyroid gland. Colloid is practically synonymous with gelatinous and with glutinous and is simply morphologically and microchemically descriptive of certain products of cell activity or disintegration. Mucoid is perhaps more specifically descriptive, as the particular substance found is largely composed of mucin and is modified mucus.

Colloid carcinomas may occur in almost every organ having epithelial cells normally producing, or capable of producing, mucus. They occur most commonly in the gastro-intestinal tract, stomach, large bowel, and appendix, but are occasionally met with in the gall-bladder, bronchus, breast, ovary, cervix, urinary bladder, kidney, and salivary glands.

Some differences of opinion have been expressed with regard to the origin of the gelatinous substance, but the following observations seem definitely to prove its origin from the epithelial cells of the carcinoma.

The mucinous droplets are seen arising within the protoplasm of the epithelial cells, and in adenocarcinoma they are found within the acini. Epithelial cells containing these droplets can practically always be found in the immediate vicinity of the extracellular mucin. Metastatic growths show similar mucus-containing epithelial cells, but never have colloid carcinoma cells, unless the colloid characteristics can be found in the primary growth.

A slight amount of mucus of connective-tissue origin may be present in colloid carcinoma, although it is not easily demonstrated as typical mucus. Connective tissue is rarely found; the picture is rather one of mucus forcing its way between and separating the connective-tissue fibres. Ziegler asserts that myxomatous degeneration of the connective tissue may occur in portions of a carcinoma and thus simulate true colloid carcinoma, particularly in the breast. He suggests that such growths be called *carcinoma myxomatosium.*

Epithelial mucin arises normally from all mucous membranes, and a pseudomucin is sometimes found in the ovary; at one time during the process of lactation, mucin is found in the epithelial cells of the breast. Under pathologic conditions the quantity of mucus may become largely increased. Wells says: "As epithelial mucin represents a distinct product of specialized

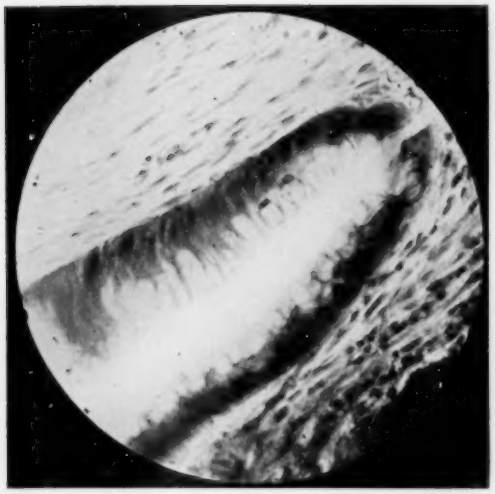

FIG. 1.—(70127). Colloid adenocarcinoma of the cæcum. Columnar type of cells with basilar nuclei and mucous formation within the protoplasm. (x250.)

FIG. 2.—(208874). Colloid adenocarcinoma of ascending colon with columnar cells. (x50.)

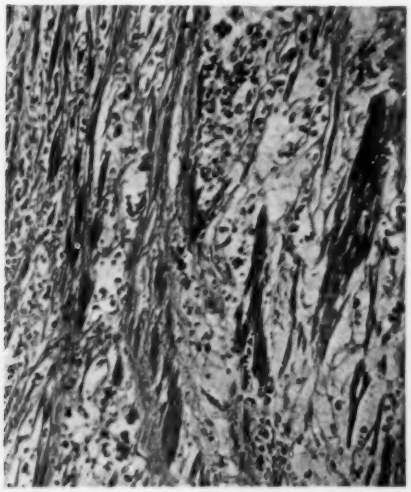

FIG. 3.—(208874). Colloid carcinoma with only slight tendency toward a sinuous formation. Same case as Figure 2 but independent lesion in cæcum 12 cm. below. (x50.)

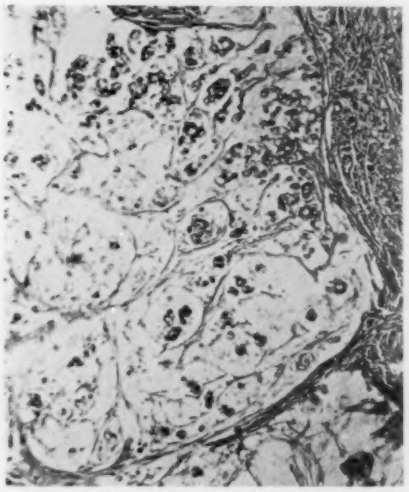

FIG. 4.—(178416). Colloid carcinoma of the cæcum. Accumulation of mucus within cells resembling signet rings. (x50.)

cells, it is questionable if the ordinary application of the term degeneration, in the sense of the conversion of cell-protoplasm into mucin, is correct. . . . Catarrhal inflammation is merely an excess of normal secretion . . . and . . . even in the extreme example of mucoid degeneration seen in carcinomas derived from mucous membranes (the so-called colloid cancers), the epithelial degeneration is not necessarily to be interpreted as a conversion of cell-cytoplasm into mucin, but is largely due to the pressure of secreted mucin upon the cells within the confined spaces of the tumor."

Histogenesis.—A state of confusion exists with regard to the histogenesis of colloid carcinoma. Prudden, Hamilton, Councilman and others regard colloid carcinoma as a degeneration, though perhaps by some the term is used loosely, as is *carcinomatous degeneration.* Ohlamacher compares it to fatty, hyalin, and amyloid degeneration. Adami calls it colloid degeneration, but regards the colloid as a secretion, as do Gaylord and Aschoff. Ziegler defines mucoid carcinoma as "that form of carcinoma in which the epithelial cells produce mucus or a more colloid-like gelatinous substance." He remarks: "In the intestinal cancers the formation of mucin takes place in goblet-cells, occurring under normal conditions."

Colloid formation may be manifest in the earliest stages of tumor formation. In many of the cells of most malignant tumors there are definite degenerative changes which are largely a pressure necrosis, secondary to mucoidal accumulation. Other carcinomas show degenerative changes in the cells without a sign of the mucous droplets, either extracellular or intracellular. Colloid carcinomas that metastasize practically always show colloid in the metastatic growth, probably because the carcinoma is composed of colloid cells and other malignant cells not possessing the inherent characteristics necessary to produce mucus. Broders has called attention to epitheliomas composed of various degrees of differentiation. The colloid seems, therefore, to be the result of a secretory activity of the carcinoma cells and is a sign of partial differentiation.

As is expected from the rate of cellular division, colloid carcinomas are usually of slow growth in spite of the accumulation of colloid. It must also be noted that most colloid carcinomas have at least a tendency to acinar formation.

Composition.—The colloid material of carcinomas is a mixture of mucin and varying amounts of other proteins derived from cell disintegration and from vascular exudates. Wells writes: "Mucin in its typical form is a compound protein, consisting of a protein radical and a conjugated sulphuric acid which contains a nitrogenous sugar. Hence, when boiled with acids, mucin yields a substance reducing Fehling's solution. Mucin is acid in reaction, probably because of the presence of the sulphuric acid, and, therefore, is characterized microchemically by staining with basic dyes. It is readily dissolved in very weak alkaline solutions, is precipitated by acetic acid, and its physical properties, when in solution, are quite characteristic." In ovarian

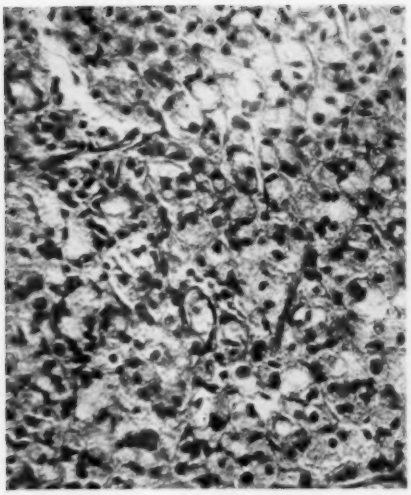

FIG. 5.—(178416). Same as Figure 4, higher magnification. (Note resemblance to hypernephroma.) (X100.)

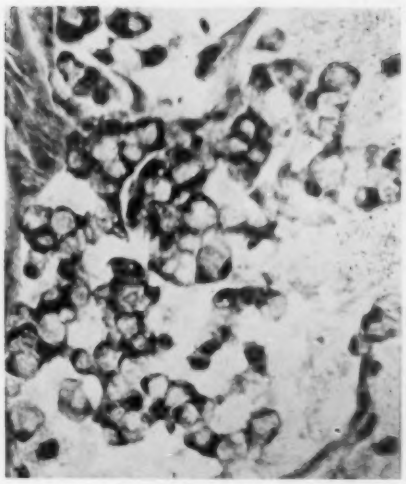

FIG. 6.—(178416). Same as Figures 4 and 5, higher magnification. (X200.)

FIG. 7.—(178553). Colloid adenocarcinoma of the breast. (Note colloid material within acini and within individual cells.) (X200.)

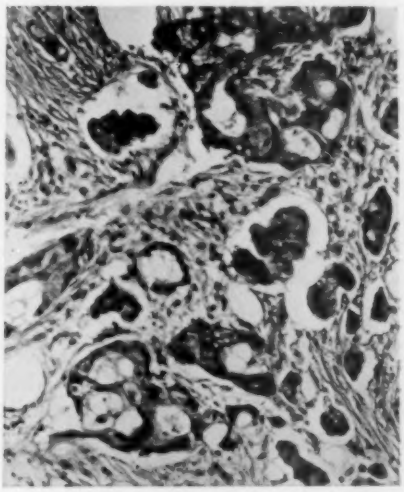

FIG. 8.—(178553). Colloid adenocarcinoma metastasis in axillary gland. Same case as Figure 7. (X100.)

tumors the colloid material contains a pseudomucin which is not precipitated by acetic acid and is alkaline in reaction.

Wells says that the presence of mucin in the tissues causes no reaction and its absorption is not harmful. Trotter, on the other hand, in examining a specimen removed from the omentum in a case of colloid carcinoma of the peritoneum, found that the colloid material had penetrated by vascular processes derived from the connective tissue of the peritoneum.

Signs of Cellular Differentiation.—Carcinoma tissue may or may not show other signs of cellular differentiation. Thus, the colloid characteristic may occur in various types of carcinoma: (1) simple (medullary and scirrhous) with little sign of other differentiation, (2) adenocarcinoma which may be of the small or the large and cystic type; the cells may be low cuboidal with little differentiation, or columnal with nuclei arranged orderly at the base of the cells, and (3) papillary adenoma.

The colloid material varies much in quantity. There may be small areas of colloid carcinoma surrounded by malignant cells with no sign of colloid. Sometimes the tissue is a mass of jelly-like substance replacing over large areas the cellular structure. The carcinoma cells of the colloid masses may be in "tufts" or in slightly curving rows like arcs of circles, as if the accumulating colloid within had burst large acini asunder. In other tumors the colloid may occur almost exclusively within the carcinoma cells; in some cases every carcinoma cell is overdistended with the substance, giving a signet-ring appearance. In this type there is but little tendency toward acinar formation. In some cases there are masses of colloid, each surrounded by a row of columnar cells containing colloid globules, with nuclei near the basement membrane; these are colloid adenocarcinoma with columnar cells. Colloid papillary adenocarcinoma is sometimes found.

Sometimes there is separation of types and metastatic areas differ in appearance from the primary site; however, it is noteworthy that often the metastatic process resembles the parent lesion to the minutest detail. An endeavor was made to determine the relative malignancy of the various morphologic types, especially of the signet-ring type, which is often homogeneous in appearance throughout the primary lesion and the transplants and glands. In the stomach there seemed to be no difference in mortality or longevity. In the cæcum the signet-ring type was most malignant and the colloid adenocarcinoma with columnar cells, least malignant.

Practically all colloid carcinomas show a slight tendency toward acinar formation. The signet-ring type, however, shows little acinar formation or any sign of differentiation other than colloid production, and this may explain its seeming greater malignancy in the cæcum.

General Clinical Characteristics.—Colloid carcinomas seem, in general, to be slower growing than carcinomas without colloid. They are slower to metastasize; there is less tendency toward fibrous encapsulation, and the carcinoma is hard to eradicate even when there is only local glandular involvement. In this respect it resembles the ependymal-cell glioma of the coccyx.

Fig. 9.—(271356). Colloid adenocarcinoma of the breast, showing colloid within cells. High power. (x1000.)

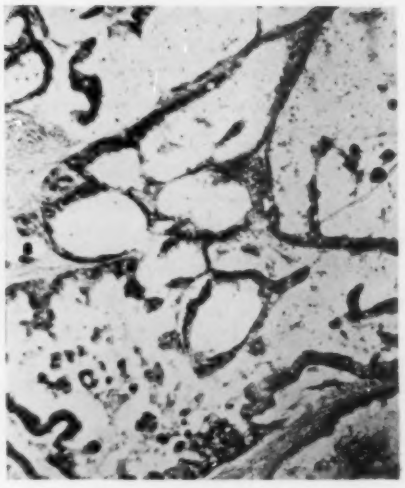

FIG. 10.—(91370). Primary colloid carcinoma of the kidney. (x50.)

FIG. 11.—(91370). Colloid carcinoma of the kidney. Colloid arising within cells and forming large extracellular masses. (x100.)

Growth seems to be chiefly by expansion and permeation, and transplants are common. The tumor is extremely friable. In colloid carcinomas of the gastro-intestinal tract after the growth reaches the serosa, and is seen as a smooth, glistening nodule, the colloid material often breaks through, carrying with it carcinoma cells which transplant on the peritoneum, remain free in the peritoneal cavity as masses of jelly-like substance, or dense tapioca-like bodies. There is no relative difference in the age of patients with colloid carcinoma and other types of carcinoma.

Colloid carcinomas have, in general, a higher mortality than other malignant growths, but longevity is greater and metastasis later.

Findings in 203 Patients with Colloid Carcinoma of the Gastro-intestinal Tract.—Two hundred three patients with colloid carcinoma of the gastro-intestinal tract who were operated on at the Mayo Clinic from January 1, 1910, to January 1, 1921, form the basis of this study. Diagnosis was confirmed on pathologic examination. The cases are grouped according to the organs involved.

Stomach.—Colloid carcinoma of the stomach is quite common. Welch, in a review of 1221 malignant growths of the gastro-intestinal tract, found colloid carcinomas in 2.5 per cent., and von Klein, in 395, found 5 per cent.

During the period of this study, 784 carcinomas of the stomach were diagnosed in the Mayo Clinic from specimens removed at operation. Colloid carcinomas were found in fifty-one patients, thirty-seven males and fourteen females. The average age was fifty-four and seven-tenths years. Explorations were performed in eight instances and resections in forty-three; thirty patients recovered from operation. The results of treatment in twenty-three patients are shown in Table I. In nineteen patients who survived operation but died eventually, the average duration of symptoms before operation was nine and four-tenths months, and the average longevity after operation twenty-one and two-tenths months, a total duration of thirty and six-tenths months. In seven traced cases in which exploration only was done, the total duration of the disease was fifteen and two-tenths months.

All types of colloid morphology were found occurring with or without, other signs of differentiation. Almost all specimens showed slight tendency toward acinar formation. There is no definite difference in the relative mortality or longevity in the different types of colloid carcinomas of the stomach.

As compared with other types of carcinoma of the stomach, the relative frequency of colloid carcinoma of the stomach is practically the same in males and females; longevity is greater; pre-operative symptoms are practically the same and of equal duration; the average duration of pre-operative symptoms is slightly longer in cases of cure; there is little difference in the percentage of cures. Thoma says that colloid carcinoma of the stomach is more malignant than carcinoma showing no colloid change. Colloid carcinoma has a tendency to infiltrate the wall of the stomach widely and there seems to be less attempt at connective-tissue encapsulation. In certain cases the colloid cells had penetrated the whole thickness of the stomach, involving the serosa widely without

involvement of glands. Metastasis to the viscera is found less often and is relatively late; there is less tendency to early involvement of distant glands.

Appendix.—Four carcinomas of the appendix were found during laparotomy for other reasons. This is 7 per cent. of fifty-eight cases of carcinoma of the appendix occurring at the Mayo Clinic during the period of this study. Three patients have been heard from. Two, in whom the growth was confined to the appendix alone, are well, but in the case of the third patient, the carcinoma had ruptured and a large quantity of jelly-like material was found in the peritoneal cavity. This patient had been under Röntgen-ray treatment and was in a serious condition two years after operation.

Cæcum and Ascending Colon.—There were sixteen cases (22.2 per cent.) of colloid carcinoma of the cæcum in seventy-two cases of carcinoma of the cæcum and ascending colon. The average age of the patients was forty-nine years. Resection was performed in fourteen instances, exploration in one, and ileocolostomy in one. Of eight patients traced, two and one-half years after operation, three (37.5 per cent.) are alive and five are dead. Two patients had lived three and one-half years after operation.

As compared with carcinoma of the cæcum in general, colloid carcinoma of the cæcum has greater eventual mortality but greater longevity. Local glandular involvement was present in all cases except two. Colloid tumors showing cellular morphology of the signet-ring type seemed more malignant; those of the glandular type with columnar cells were least malignant.

Transverse Colon.—There were twelve cases of colloid carcinoma of the transverse colon in this series, 7.3 per cent. of 165 cases of carcinoma of the transverse colon. Of five patients concerning whom information was received three years after operation, three (60 per cent.) are living; one of these had glandular involvement and two did not. Both of the patients who died had glandular involvement. These few cases of colloid carcinoma of the transverse colon showed a large percentage of cures.

Sigmoid.—There were six cases of colloid carcinoma of the sigmoid in this series, 4.3 per cent. of 138 cases of carcinoma of the sigmoid. Information was obtained concerning three patients, all of whom were dead. Hayes, in an analysis of 100 cases of carcinoma of the large intestine at the Mayo Clinic, draws these conclusions:

1. Adenocarcinoma is present in every carcinoma which originates in the large intestine.

2. Colloid carcinoma occurs in about 16 per cent. of the cases.

3. Colloid carcinoma metastasizes and is often present in the most highly malignant cases.

4. Colloid carcinoma is very difficult to control after it begins to metastasize.

5. A very high percentage of local glands are involved in the second type of colloid carcinoma.

Rectum and Rectosigmoid.—The thirty-eight cases of colloid carcinoma of the rectum and rectosigmoid in this series were 5.5 per cent. of 693 cases

of carcinoma of the rectum and rectosigmoid, in which operation was performed between January 1, 1910, and January 1, 1921. Von Klein found 12.8 per cent. in seventy-eight cases.

There is little difference in the post-operative results in colloid carcinomas of the rectum and other carcinomas. As in all carcinomas of the rectum, colloid carcinomas tend to invade the glands late, and local glands are often involved long before distant glands. Metastasis to the viscera is rare and late. In cases of colloid carcinoma with glandular involvement there were three-year cures in 25 per cent.; whereas in cases without glandular involvement there were three-year cures in 43 per cent. Patients cured had symptoms longer than those who died of recurrence.

The average age of patients cured was sixty-five years, of those who died, forty-six years. Average post-operative life of patients who died, on whom resection was performed, was nineteen months, and the total duration from onset to death was thirty-two months. In cases of colloid carcinoma showing the columnar-cell adenomatous type of morphology the average post-operative life was longest.

Colloid carcinoma of the rectum seems particularly susceptible to treatment with Röntgen-ray and radium. A certain degree of gland formation could be found in practically every specimen.

Colloid carcinoma of the large intestine has a tendency to spread widely over a considerable length of the bowel; there is less tendency to stenosis in the rectum because of less connective-tissue formation. The growth is productive of large masses, often forming a thick, rigid tube; ulceration may be early and the cavity large.

Peritoneum.—Colloid carcinoma of the peritoneum usually presents a characteristic picture. The parietal and visceral peritoneum is studded with large and small soft glistening nodules. The cavity contains more or less jelly-like material, often round, hard, gelatinous bodies resembling tapioca or fish eggs. Adhesions may be present in abundance, matting together the intestine. The microscopic picture is one of an abundance of colloid with scarcity of cellular elements. These are usually of the columnar type and arranged in chains. Their protoplasm shows accumulating mucous droplets.

Many cases of colloid carcinoma of the peritoneum have been reported in the literature, probably all secondary to a primary growth in one of the abdominal organs. Péan applied the term, *gelatinous disease,* to the condition. Werth, in 1884, introduced the term, *pseudomyxoma peritonei;* the terms *gelatinous ascites* and *carcinomatous ascites* have also been used. Pye-Smith, in 1893, reported a celebrated case in which 299 paracenteses were performed during a period of nine years. At necropsy a papillomatous tumor of each ovary was found. Trotter, in 1910, reported a case in which the disease originated in the appendix with metastatic, gelatinous masses in the omentum, parietal peritoneum, and cæcum. The appendix could not be found. A specimen from the omentum was removed and diagnosis was made of colloid carcinoma. Many of the cells were distinctly columnar in character.

Nothing further was done and the patient appeared entirely well eighteen months later. Spontaneous cures have also been reported by Lejars and Eden. In the case reported by Eden, the growth was of ovarian origin. A second operation was necessary for recurrence two years later, and nearly two years after the second operation the patient was reported well. Lejars says that colloid carcinoma of the ovary is more malignant than that of the appendix. Trotter found considerable reaction to the colloid masses, which were penetrated by the connective tissue of the peritoneum, the endothelial cells often growing over the masses. He thought that perhaps the columnar cells found were of peritoneal origin. McCrae and Coplin add a case in which forty-seven paracenteses were performed during four years. At necropsy the abdomen was found filled with gelatinous material and the intestines with other abdominal viscera were matted in one mass of adhesions. The omentum was absent. The origin of the growth could not be determined. A few specimens were found showing small areas in which there were papillary growths lined by columnar epithelium containing mucoid droplets. Gelatinous nodules found between the lobes of the left lung just under the pleura were believed to be carcinomatous.

It would seem possible to tell whether these cases were of ovarian or extra-ovarian origin by chemical means. The gelatinous material produced by cells of ovarian origin contains pseudomucin, soluble in alkalin solutions, not precipitated by acetic acid and stained by acid stains. The cells arising from the gastro-intestinal tract produce mucin which is soluble in water, of alkalin reaction, precipitated by acetic acid, and stained by basic stains.

There were thirty-seven cases of colloid carcinoma of the peritoneum of uncertain origin in this series. This is 16 per cent. of a total of 232 cases of abdominal carcinoma. Of fourteen patients traced, two were living and responding remarkably well to large doses of Röntgen-ray and radium. One patient had lived eleven years since operation and twelve were dead, seven less than one year after operation, two less than two years, one less than three years, and one less than four years.

The clinical features of colloid carcinoma of the peritoneum are ascites and multiple abdominal masses. Trotter says that those of appendicular origin come under observation in four ways: (1) as an unexpected condition found at necropsy and without previous clinical symptoms; (2) as a cause of slow but pronounced abdominal enlargement; (3) as an unexpected discovery during an operation for hernia, and (4) during operation for appendicitis. In the Clinic series the diagnosis of tuberculous peritonitis was often made. The striking feature of the disease is its protracted duration and, as in two of our cases, its remarkable response to Röntgen-ray and radium.

Gall-bladder.—Colloid carcinoma of the gall-bladder is not uncommon. In 100 cases of carcinoma of the gall-bladder Trentlein found eight colloid carcinomas.

Salivary Glands.—Colloid carcinoma is occasionally found in the salivary glands. Adenocarcinomas may contain mucus within the individual cells, as

in small alveolar carcinoma, or as collections occurring in the cylindroma. The latter are not true colloid carcinomas, but rather connective tissue, mucinous, or myxomatous growths. One case of colloid carcinoma, probably arising in the salivary glands, occurred in this series. Tumors were removed at various times from the right side of the neck and infraclavicular region, right submaxillary glands, deltoid muscle, biceps muscle, forearm, and left thigh.

Pancreas.—Two cases of primary colloid carcinoma of the pancreas occurred in the series. A man, aged sixty-nine years, gave a history of tumor and epigastric pain of three months' duration. A large cyst containing mucinous material was found and drained. A specimen removed proved to be colloid carcinoma. Death occurred ten weeks after operation. The other case proved inoperable on exploration and the patient died within fifteen months.

Groin.—Two abscesses of the groin, when drained and examined microscopically, proved to be colloid carcinoma. The primary origin was probably in the colon.

Bladder.—Six cases of colloid carcinoma of the bladder were found, 2.5 per cent. of 241 cases of cancer of the bladder. Of six patients with colloid carcinoma of the bladder two were living, one three years and one eighteen months after operation. The average duration of life was two years. Scholl found 41.9 per cent. of patients with malignant papilloma of the bladder living three years after operation.

Colloid carcinoma (adenocarcinoma) of the bladder is somewhat more malignant than malignant papillomas and slightly less malignant than solid carcinomas of the bladder.

Kidney.—There was one case of colloid carcinoma of the kidney. The patient, a woman aged sixty-seven years, died one year after nephrectomy. Symptoms had appeared one year before operation.

Prostate.—One case of primary colloid carcinoma of the prostate occurred in the series.

Ovary.—There were four cases of colloid carcinoma of the ovary in the series, 1.1 per cent. of 363 ovarian carcinomas. All of these patients traced are dead.

One patient, aged forty-three years, had had symptoms for six months. At operation bilateral ovarian colloid carcinoma in cystadenomas with peritoneal involvement was found. She died eleven months after operation. One patient (Case A328293), who was operated on for colloid carcinoma in fibroma of the ovary, has not been traced. One patient, aged twenty-eight years, died with a ruptured ovarian cystadenoma and colloid carcinoma. The fourth patient, aged sixty-three years, had colloid carcinoma, probably of ovarian origin, involving the pelvic organs. She died three years and ten months after operation.

Cervix.—There was one case of primary colloid carcinoma of the cervix with involvement of the vagina in a woman aged sixty-one years. Symptoms

had persisted for two years. The condition was inoperable and repeated radium treatments were given. Two years after examination, the patient's condition was very much improved.

Colloid carcinoma of the cervix is rare. Miller collected five cases of carcinoma of the cervix in which the alveoli were filled with mucus and the stroma was unaffected. Albrecht and Cullen reported a case in which both cervix and uterus were involved. Williams suggests the origin as aberrant intestinal or ovarian glands, but this would seem less likely than an origin from the mucous glands of the cervix.

Breast.—There is much disagreement with regard to the origin of the mucus of colloid carcinoma of the breast. Lange regarded the colloid as arising from mucous degeneration of the connective tissue without direct participation of the cancer cells. Too much reliance cannot be placed on the toluidin stain reaction, as mucus has a complex nature which makes sharp distinctions in staining reactions impossible. Kaufmann accepts Lange's theory unreservedly. Ziegler believes the colloid arises from the cancer epithelium, but says that a mucous connective tissue is sometimes present in carcinoma of the breast; he suggests that the growth be called myxomatous carcinoma if the mucus is entirely of this origin. Borst suggests a double origin of the colloid: the connective tissue and the carcinoma cell. Mallory regards it as arising, at least in part, from the epithelial cells. Schmaus divides colloid cancer of the breast into mucoid-stroma carcinoma and colloid carcinoma. Ribbert says that, in the places where colloid formation was noticeable in its beginning, mucus was secreted into the cavity of the gland ducts, and that these mucous masses later broke through the epithelial covering, came out into the surrounding stroma, and penetrated between the connective-tissue fluids, thus loosening it and making it resemble mucous connective tissue. He says that in colloid carcinoma there is no typical mucous tissue with characteristically formed and arranged cells, but only a swelling of the connective substance. There is nothing histologically in this to point to an independent process. He, therefore, overthrows the distinction of colloid carcinoma in which the mucus is said to be derived from connective tissue and colloid carcinoma in which the mucus is said to be derived from epithelium. He maintains that there is but one source of mucus in colloid carcinoma, the epithelial cells.

In this series of cases, a definite epithelial origin was found; in no case could mucous connective tissue be made out. For carcinoma cells of the breast to produce colloid does not require so great a metamorphosis of the cell as would at first appear. Williams calls attention to the fact that, during the process of lactation, the epithelial cells of the breast at one time show mucus production. There is, on the other hand, no direct connection between lactation and the occurrence of colloid carcinoma, for it has been found in the breasts of virgins. Colloid carcinoma in the breast as elsewhere, metastasizes true to type, and colloid production seems an intrinsic characteristic of the cell. It is not, therefore, a true degeneration, but must be regarded as a

TABLE I

Results in Twenty-three Patients with Colloid Carcinoma of the Stomach

	Alive and well three years or more	Dead	Recurrence
Patients with glandular involvement 15 (65 per cent.)	4 (26.6 per cent.)	11	
Patients without glandular involvement 8 (35 per cent.)	3 (37.5 per cent.)	4	1
Total	7 (30.4 per cent.)	15	1

TABLE II

Results in Twelve Patients with Colloid Carcinoma of the Breast

	Living and well	Living with recurrence	Dead
Patients traced 12	4	2	6
Average post-operative life, years	2.4	1.5	3.5
Patients traced, operated on three years ago 8	2	1	2
Patients with glandular involvement 8	2		6
Patients without glandular involvement 4	2		2

TABLE III

Results in 218 Patients Operated On

	Alive three years after operation	Alive five to eight years after operation
Patients without glandular involvement 86 (39.5 per cent.)	65 (75.6 per cent.)	55 (63.9 per cent.)*
Patients with glandular involvement 132 (60.5 per cent.)	48 (36.6 per cent.)	25 (18.9 per cent.)†
Total, 218	113 (51.8 per cent.)	80 (36.7 per cent.)

* Six had recurrences.
† Three had recurrence.

secretion. A few cases have been found in which the recurrent and the metastatic nodules showed no trace of colloid. Lange reported six such cases in forty-nine collected cases of colloid carcinoma of the breast. This need not necessarily be due to excessive metamorphosis, as it is regarded by Gaabe, since in many colloid carcinomas there are areas of malignant cells entirely without colloid production; the metastatic recurrence might be of these cells and not the colloid cells.

Lange, in a collection of 1814 cases of carcinoma of the breast, found the colloid type in 0.93 per cent.; later compilation of 2944 showed 1.66 per cent. Gross found 1.34 per cent.; Deaver and McFarland 1.73 per cent. There were twenty-one cases (1.12 per cent.) of colloid carcinoma in 1870 carcinomas of the breast operated on in the Mayo Clinic between January 1, 1910, and January 1, 1921 (Table II). Sistrunk and MacCarty report results in 218 cases of carcinoma of the breast (Table III). Gaabe says that the growth of colloid carcinoma of the breast is much slower and the suffering twice as great as in other types of carcinoma of the breast. The prognosis is no more favorable. Life expectancy is therefore less in colloid carcinoma than in other types of carcinoma. Less than half the patients complained of pain; in only 18 per cent. was it severe. Ulceration of the skin and metastasis to the glands occur later and in a smaller percentage of cases than in other types of carcinoma. Gaabe says that metastasis is two and one-half times as late, that late recurrence is more common, and three times as great. (Figs. 1–11.)

CONCLUSIONS

1. In colloid carcinoma the epithelial cells possess an uncontrolled function of secreting a mucinous substance. Its accumulation is often destructive of the carcinoma cells.

2. Mucus formation is a sign of functional differentiation of the carcinoma cells, corresponding to the morphologic differentiation seen in carcinomas with cells of the acinar or columnar type.

3. The mucous-forming characteristic may be possessed by cells showing other morphologic signs of differentiation and by those not showing such differentiation.

4. Colloid carcinomas occur in the stomach (6.5 per cent.); cæcum (22.2 per cent.); appendix (7.0 per cent.); transverse colon (7.3 per cent.); sigmoid (4.3 per cent.); rectum (5.5 per cent.); pancreas (two cases); gallbladder (8 per cent.); salivary glands (one case); bladder (2.5 per cent.); prostate (one case); kidney (one case); ovary (1.1 per cent.); and breast (1.12 per cent.). Peritoneal carcinomas occur in 16 per cent. of all cases.

5. Colloid carcinoma is usually slow of growth and late to metastasize to glands and other organs. It often grows by permeation and may cause extensive thickening of the wall of the affected organ.

6. Local glands are often involved long before metastasis has reached distant glands. Though histologically less malignant on account of permeation of adjacent tissues, it is particularly difficult to eradicate. Death is often

delayed, but the eventual mortality is greater than in other types of carcinoma.

7. Recurrence is often entirely localized to the site of origin.

8. Many patients with colloid carcinoma respond remarkably well to treatment by Röntgen-ray and radium.

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BONE TUMORS. METASTASIS TO LUNGS FROM A PURE MYXOMA

(REPRINT 115)

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of Baltimore, Md.

In the Annals of Surgery for December, 1920 (vol. lxxii, p. 713) I reported on central and periosteal myxomas and their recurrence after exploratory incision and piecemeal removal. Case II in that report (Pathol. No. 22,929), central myxoma of the astragalus, has just come under observation because of pain in the chest and elbow, and the X-ray (Fig. 1) shows shadows in the lung which are apparently metastatic tumors.

The tissue first curetted from the astragalus, the recurrent tumor in this scar, and the metastatic area in the tubercle of the tibia have the gross and microscopic appearance of a pure myxoma. There were no cellular areas resembling sarcoma.

Case I reported in the same paper, after frequent recurrences in the region of the first wound and later throughout the shaft of the humerus, died ten years after the first operation with evidence of metastasis to the lung and scalp. I have studied the gross and microscopic appearances of all the tumors in this case, and the picture remained throughout, that of a pure myxoma.

We therefore have pretty definite evidence that this type of tumor may give rise to metastasis as well as to local recurrence. The interval in the first case between the first operation and the metastasis to the lung was about ten years; in the second case, between the first operation, curetting of the astragalus, and the X-ray evidence of metastasis to the lung, four and one-half years. This is later than usual when compared with true sarcoma of bone.

Doctor Codman of Boston, in charge of the registry of bone tumors, informs me that his consulting group of pathologists is somewhat skeptical as to whether there is a true and pure myxoma of bone. The older pathologists describe it with the remark that it is a benign tumor of bone, but always recurs. Apparently they were not familiar with its metastases.

My studies of myxoma of bone first published in the December numbers of *Progressive Medicine* and later in the Annals of Surgery just referred to, and again mentioned in the *Journal of Orthopædic Surgery* for November, 1920 (vol. ii, page 597) lead me to the conclusion that there is a pure myxoma of bone with a distinct gross and microscopic appearance. In view of the many operations in Case I and my two operations in Case II recorded in the Annals of Surgery, I have had ample opportunity to see it in the fresh and in the frozen section.

Gross Fresh Appearance.—When the soft-part or bone capsule of the tumor is opened, viscid gelatinous material exudes under pressure, resembling somewhat tapioca. It may be blood-stained in various shades. When the tumor is pure myxoma this gross appearance is the same throughout. In the

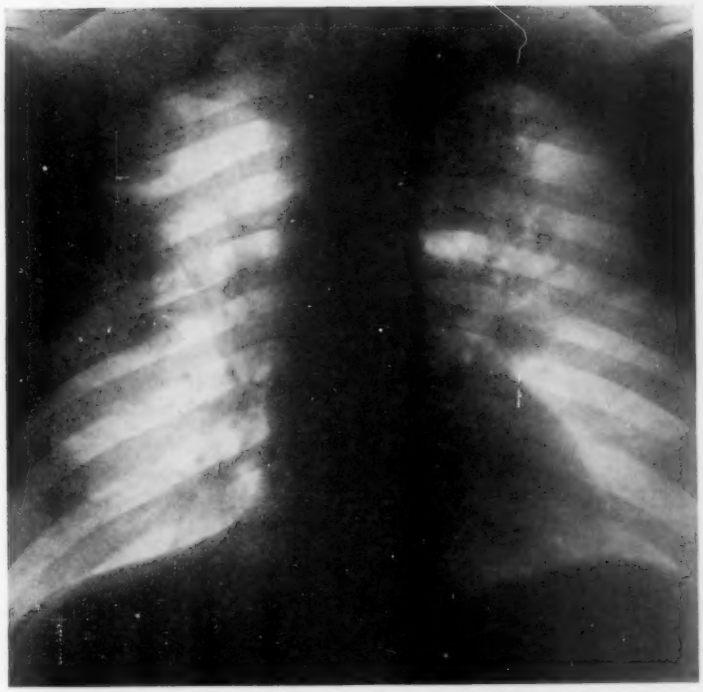

FIG. 1.—Skiagraph of thorax in the case of myxosarcoma of the astragalus, showing metastases in the lungs.

ANNALS OF SURGERY (*l.c.*), Figs 4, 9 and 10 picture this appearance after hardening in formalin. Formalin, however, or any other hardening agent condenses the tumor, but it still remains soft and friable.

The *frozen sections* are more characteristic than sections made after long hardening, and the gross tissue preserved in the laboratory never again shows the typical histological picture. This apparently is due to the fact that the intercellular substance contains so much fluid and so little connective tissue that it is contracted and later sections look more cellular. Figure 2 in the ANNALS OF SURGERY (*l.c.*) picture the histology in the fresh state.

As a pure tumor the myxoma is rare. It is often mixed with cartilage, but much more frequently with sarcoma.

As I read over the pathological reports of a number of pathologists, I find that ostitis fibrosa has now and then been diagnosed myxoma or myxosarcoma, and many pure chondromas have been diagnosed myxoma or myxochondroma. As ostitis fibrosa is distinctly benign and practically never recurs even after incomplete removal, and as the pure chondroma only recurs when improperly or incompletely removed, there have been a large number of cases recorded as myxochondroma and myxosarcoma which have remained well after operation, and therefore suggest to the surgeon and pathologist that it is a relatively benign tumor.

The three cases of myxoma which I have personally studied and therefore feel confident of the diagnosis and which were explored and removed piecemeal at the first operation, have all recurred. One died of metastasis after ten years, another after four years, and the third is now under observation with metastasis to the lung.

Clinical and X-ray Diagnosis.—If one will look at the illustrations in the ANNALS OF SURGERY and in the *Journal of Orthopædic Surgery,* one will see that there is nothing characteristic in the clinical picture or X-ray of either the periosteal or central lesion. Therefore, if one must explore in order to avoid unnecessary resection or amputation—and this is imperative, because of the common occurrence of non-malignant bone lesions—one should always bear in mind the possibility of a myxoma and there must be a devised technic to prevent, if possible, transplantation of this tumor tissue into the wound. I know of no other tumor tissue which transplants more readily than the myxoma. Up to the present time the only technic we have is the employment of the electric cautery in the exploratory incision and the use of chemical cauterization with pure carbolic followed by alcohol and a fifty per cent. solution of zinc chloride.

Up to the present time I have no more evidence than that published in the two articles referred to, and this second report on myxoma is made chiefly to record and picture the metastasis to the lung in Case II, and to again emphasize that any bone tumor which contains typical myxomatous areas is for practical purposes as malignant as a sarcoma.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held October 9, 1922

The President, Dr. John H. Jopson, in the Chair

TRAUMATIC POPLITEAL ANEURISM

Dr. Hubley R. Owen presented a man in whom this condition had developed.

Dr. A. P. C. Ashhurst raised the question whether this was really a case of traumatic popliteal aneurism. It is possible that he had the aneurism before he got hurt. If it developed after the injury, it seems more likely to be an arteriovenous fistula than an aneurism. Apparently, the examination has not been complete enough to show whether the branches of the femoral artery below the aneurism pulsate or not. From a practical point of view, he thought the thing to do was to cut down and see what it was. After three months there would have been developed a sufficient sac wall to suture, and it was quite possible that it was not the main trunk of the popliteal that was involved but a branch.

RECURRING PERFORATIONS OF STOMACH AND DUODENUM

Dr. H. A. McKnight presented a man, aged thirty-three, who was first admitted to Dr. Morris Booth Miller's service at the Polyclinic Hospital October 2, 1908, complaining of pain in the epigastrium, gaseous eructations and chronic constipation. He was operated two days after admission.

In the stomach was found a punched-out ulcer, perforated, on the lower and under side, about an inch from the pylorus. The ulcer was turned in with a purse-string suture.

The patient was again admitted to the hospital February 2, 1910, with a history that four weeks following his operation he began to have attacks in which his stomach would swell and he would suffer from pains of a sickening character in the epigastrium. The pains are very severe and last for several hours. Several hours following the acute attack he regurgitates a large amount of gas and some fluid and feels relieved. After this the pain disappears very rapidly. These attacks of pain were repeated every three or four weeks and are confined to the epigastrium. Examination at this time showed nothing but an incisional hernia in operation scar. He was again admitted to hospital January 22, 1911. He now gives a history that two months before admission symptoms became worse and he began having severe pains in the abdomen at the lower costal margin about 1.5 inches from the mid-line. These pains would last from a few minutes to several hours and were worse at night.

They were sometimes relieved by eating and sometimes followed the taking of food. Two weeks ago he began to vomit. Vomitus clear fluid. Abdomen distended with gas.

At operation, January 23, 1911, the pylorus was found almost occluded by old scar. The posterior wall of stomach was exposed in the usual manner and a posterior gastro-enterostomy performed. Hernias repaired. The next hospital record of this patient is March 1, 1920, when he was admitted for one day with a diagnosis of acute indigestion. He was admitted again January 1, 1921, with a diagnosis of gastroptosis and partial closure of the gastro-enterostomy stoma. He gives a history of pain in the epigastrium, diarrhœa and abdominal distention.

X-ray examination, marked gastrectasis and retention of about one-fourth of the opaque meal at the end of twenty-four hours. No evidence of gastro-enterostomy. No evidence of carcinoma, though the pylorus could not be clearly defined because of a very large stomach. Obstruction most likely due to the cicatrix of an old ulcer.

January 21, 1921, the abdomen was reopened through an upper right rectus incision; gastro-enterostomy opening enlarged. A Rovsing gastropexy performed and the greater curvature of the stomach sewed to the anterior abdominal wall. Stomach was opened but no evidence of ulcers found. Patient felt fine until March 23, 1921, except for an occasional pain in the epigastrium. He was admitted to the hospital March 23, 1921, with the history that he ate his lunch and felt all right; three hours later he began to feel bloated in the upper abdomen and to have severe pain in the epigastrium. He did not vomit until medicine was given. He was admitted about eight hours after onset of symptoms in great pain and shock with a board-like rigidity of the upper abdomen, and enormous distention.

Operation performed at once. Upper right rectus incision. On opening the peritoneum a large amount of air escaped. The peritoneal cavity was full of fluid. There were many dense adhesions between the stomach and the anterior abdominal wall the result of the suspension. The stomach was also adherent to all surrounding structures: liver, gall-bladder, colon, etc. Due to the plication of the stomach it was with great difficulty delivered, but on delivery a small perforated ulcer was found on the anterior surface of the stomach near the greater curvature and toward the cardia. It was quite some distance from the gastro-enterostomy, which was found patulous, no other ulcers were discovered involving the gastro-enterostomy or jejunum. The perforation was closed with a purse-string, oversewed with chromic gut, the adhesions were released, the omentum was tacked over the ulcer, and the pelvis drained. A culture from the peritoneum showed bacillus coli and streptococci. He was discharged February 6th from the hospital in good condition. On April 22, 1921, he was free from pain or discomfort. On this date another X-ray was taken, which showed a patulous gastro-enterostomy at the junction of the lower and middle thirds of the posterior surface. No evidence of a patulous pylorus. This part of the stomach ends abruptly. It is very smooth and regular. There is very marked and exaggerated peristalsis quite irregular with deep incisura and persistent

in the lesser curvature directly opposite the enterostomy. No filling defect may be due to spastic condition of stomach.

On May 18, 1922, at 6 A.M., while moving in bed patient had a sharp pain in the upper abdomen. The abdomen suddenly became distended. He was brought to the hospital at 8 P.M. Examination revealed a markedly distended abdomen tympanic all over. Pulse good, no shock, no temperature. Again the abdomen was opened; a large amount of fluid and air was found in the peritoneal cavity, with much plastic lymph and reddening and agglutination of the intestines. Stomach was inspected, no opening found. The gastrohepatic omentum was opened and a perforated ulcer found on the posterior wall of the stomach at about the middle of the organ. The lesser peritoneal cavity contained fluid. The perforation was closed with a purse-string suture of chromic gut and a cigarette drain was placed in the lesser peritoneum and pelvis.

Patient reacted very well, but after twenty-four hours showed signs of a diffuse peritonitis and died May 21, 1922, three days after onset of attack.

PERFORATING WOUND OF THE KIDNEY WITH SECONDARY NEPHRECTOMY

DR. H. A. MCKNIGHT reported the history of a case, premising by saying that incised or punctured wounds of the kidney are relatively rare, only about 200 cases have been reported, and the large majority of these are gunshot wounds and therefore are not true stab wounds.

Keen in 1896 collected 155 cases of injury to the kidney, and of these only 8 were penetrating and caused by direct stabbing. Keen also quotes Küster, who in 7741 injuries seen in the clinics of Basel and Berlin, could tabulate only ten cases of this character or about one in a thousand, and of these ten, only one was an open wound; of 2610 autopsies at the same clinics there were 13 injuries of the kidney and only one of a penetrating nature.

The case he had to report was a stab wound of the left kidney, with secondary operation about two months after the primary operation in a patient with a hæmoglobin of 12 per cent. and a pyonephrosis.

The youth, aged fifteen years, was admitted to St. Mary's Hospital May 4, 1921, after having been transported in an automobile hearse from a nearby town. He had been stabbed by another boy with a carving tool, and on admission was bleeding profusely from a wound in the loin over the left kidney. He passed bloody urine frequently and complained of pain in the loin and over the bladder region. He was operated the next day by the surgeon on service.

The kidney was exposed by a loin incision over the wound, and was found to be punctured in the lower pole on its posterior surface with a grooved wound of the cortical substance. The capsule was loosened, raised and separated for a considerable distance by extravasated blood. The bleeding was slight, and as no urine was seen flowing from the puncture, the capsule was sutured and the wound packed with gauze.

The patient reacted well from the operation, but for several days continued to pass bloody urine which finally became clear. Two weeks

after the operation he was up in a chair and three days later was up and around. The next day, however, he was suddenly seized with a sharp pain in the loin and again passed bloody urine. This condition continued. One week after operation his blood count was: reds, 1,959,000; whites, 7600; hæmoglobin, 38 per cent. On May 25th, he had a red count of 2,080,000 and 30 per cent. hæmoglobin. His blood count continued at about these figures until July 1st, one month after his injury, when he came under the care of the reporter. He now had a blood count of 1,720,000 reds, 4000 whites, and a hæmoglobin of 30 per cent., with nucleated reds, transitional cells, polychromatophilia and poikilocytosis. On July 17th, his reds had dropped to 1,390,000 and his hæmoglobin to 20 per cent.

All this time the patient had been passing blood in his urine, and at times following a severe pain in the loin, would pass complete blood casts of the ureter six to eight inches in length. He had been running a normal temperature up to this time, but suddenly his temperature rose to 104° and his white cells to 10,600 and hæmoglobin dropped to 15 per cent.

On July 20th, he was transfused with 800 c.c. of blood taken from his assailant, a boy of twelve years. His hæmoglobin now rose to 25 per cent.

One week later he had a red count of 1,150,000, a white of 24,000, and a hæmoglobin of 12 per cent. The kidney was now exposed under a very light ether anæsthesia. Many adhesions were encountered, and when the kidney was separated a large amount of pus was found internal to the organ and surrounding the pedicle, which bridged the abscess cavity. A Wertheim clamp was placed on the pedicle, but when tightened cut completely through it due to the softened and necrotic condition of the tissues. Six large clamps were applied to the stump, only a small amount of blood being lost, and the wound was packed with gauze and the patient returned to bed. The clamps were removed in five days and a light gauze packing placed in the wound.

He was discharged from the hospital October 3rd, four months after his injury with a hæmoglobin of 75 per cent. and his wound completely healed.

The removed kidney showed a perforation at the lower pole just below the middle of the organ, which extends in an upward direction, perforating the anterior surface at a higher level. On section there is found a large white organized clot about one inch in diameter involving the cortex and extending down to the pelvis; this clot is surrounded by a red clot about one-quarter inch thick.

Dr. John H. Jopson said he had operated on two cases of wounds of the kidney, due to high explosives; both required nephrectomy. One was a young man, whom he had showed before the Academy, where removal of the kidney was performed, a wound of the liver packed, and the patient recovered after a secondary empyema. The other case died of an associated wound of the liver, which is common. In both of these cases a nephrectomy was indicated due to the laceration of the kidney on the right side.

Dr. D. L. Despard said that recently he had had three cases of very diffuse hemorrhage from the kidney due to trauma, but in no case was there a wound. In one he had to open the abdomen on account of a ruptured spleen, and he had a chance to observe the tremendous hemorrhage which took place in the retroperitoneum as a result of the wound to the kidney. One case, a boy of eighteen years, bled very profusely from a ruptured spleen, and on opening the abdomen there was an extensive retroperitoneal hæmatoma. The boy's condition did not justify the removal of the kidney. In neither of the other two cases was any exploration of the abdomen made; the injury to the kidney was made evident with profuse bleeding through the bladder.

Dr. John F. X. Jones read a paper with the above title, for which see page 68.

ABSTRACT OF PAPER BY DR. DONALD GUTHRIE ON "PRACTICAL HOSPITAL PSYCHOLOGY"

Dr. Donald Guthrie, of Sayre, Pa., read a paper with the above title. He premised by saying that one of the chief causes of post-operative psychosis in the surgical patient is poor anæsthesia. He laid special stress on the advisability of having anæsthetics given by those competent and well trained. The anæsthetist should be a skilled psychologist and have a personality which can readily apply different kinds of suggestion to different individuals. At the beginning of any anæsthetic—chloroform, ether, nitrous oxid—a mixture of eight parts of suggestion and two parts anæsthetic is the best one known. If the fears of the patient can quickly be allayed by a constant stream of suggestion she will no doubt go to sleep quietly and recover from the anæsthetic in the same state of mind. The older text-books of surgery show cuts illustrating the stage of excitement during the anæsthesia. The services of five or six of the strongest helpers in the hospital were enlisted to control the patient during this period. These terror-stricken individuals invariably woke up in just the same frame of mind in which they went to sleep—kicking, struggling, screaming, and trying to flee from something terrible. Is it any wonder that these frightened, starved, dehydrated, strychnined-lashed patients had anything but a horror of our hospitals? The writer may be wrong in his belief that the subconscious mind goes to sleep last and is the first to recover in anæsthesia, but there is much evidence to support it.

The anæsthetist is the most valuable member of the operating team, and if properly trained and with the right personality, can do more to rob the surgical patient's mind of fear than anyone else.

Can anyone witness the successful anæsthetizing of young children and see child after child put to sleep without crying, without struggling, without fright, and not admire the great skill that is being shown in suggestion and hypnotism; and, after seeing a screaming, struggling child asphyxiated by a poor anæsthetist, who of us is in the position to say just how much or of what type of future mental ill health may have its origin in the fright caused by this bad anæsthesia?

For the past two years he had been using music during anæsthesia to a great deal of advantage. He had an old-fashioned sweet-toned music-box in use while children were being anæsthetized with ether. It has been remarkable to see how the music attracts the child's attention and enables the anæsthetist to put children to sleep without fright. He also uses music during the recovery from nitrous oxid and oxygen anæsthesia. When the operation is completed and the patient allowed to wake up absolute quiet is maintained. Excitement during the recovery from nitrous oxid and oxygen anæsthesia, which is so common, is greatly lessened—in fact many patients will pass into a natural sleep, and he had had many of them speak of the delightful sensations the music seems to have caused during the awakening period.

It is important to have the patient recover quietly from the anæsthetic in a recovery room. She must be administered to by a nurse who has been specially trained and who will assure her that the operation has been successfully performed and that her condition is excellent. Quiet, calm assurance at this time that everything is as it should be works better than sedatives, although it is essential that immediate post-operative suffering be controlled by morphine. He gives frequent doses of morphine for the first two or three days, and large amounts of fluids by mouth and rectum soon after operation. Everything possible is done for the comfort of these patients. After operation nurses are with them constantly and they have frequent visits from the surgical staff. The apprehensive patient who is allowed to suffer cannot be convinced that her condition is satisfactory—it is far from being so to her—and she fears an unsatisfactory or fatal outcome. The services of a corps of efficient, loyal, well-trained nurses, who love their work, and who look upon it as an art and not a trade, at this time are indispensable.

Dr. H. K. Mohler said that the hospital personnel needs to hear very frequently these points emphasized in Doctor Guthrie's paper. Nothing could do more towards improving the treatment rendered by a hospital to its patients than to require everyone who has to do with a surgical patient, to undergo an abdominal operation about once every two years. It is true that an anæsthetist who has taken an anæsthetic, all other things being equal, is a better anæsthetist than one who has not taken an anæsthetic.

The question of convalescence is one not thought of enough, and deserves greater consideration than it has received, both from the standpoint of the patient and the hospital. As soon as it is safe to move a patient he should be transferred to more pleasant and cheerful surroundings than exist in a surgical ward in the hospital. By this Doctor Mohler means preferably to a convalescent home, and incidentally it should be a home for convalescents and not for incurables. The atmosphere of this home must be one of cheer and sunshine. The transference of patients to a convalescent home as early as their condition will permit will release surgical beds which are so urgently needed in almost every large hospital at certain seasons of the year. Convalescent homes are economical both to the patient and to the hospital.

More cordial relations between attending physicians and the patients will often result in better results. Recently a surgeon told Doctor Mohler of several patients which were greatly benefited by conversation with their surgeon, who convinced them that their limitation in motion of the arms was not as great as the patient imagined. Less than five minutes talk by the surgeon resulted in the patient developing more motion in his recently healed fracture of the forearm than he believed he would ever attain.

DR. D. J. MCCARTHY said he thought the important matter to consider was whether the method put into effect by Doctor Guthrie at Sayre could not be done equally well here in the Philadelphia hospitals. Doctor McCarthy said he did not know of any better illustration than what had been accomplished in the psychopathic wards at Blockley. He said they used to be frightful, but the kindly attitude of the new chief, Doctor Ebaugh, had transformed them into as pleasant a place as it was possible for these patients to be. How would be the best way to apply Doctor Guthrie's principles to large city hospitals, like the University and Jefferson. The responsibility rests with the directors of the hospital, the staff, and they should be made individually responsible for the attitude and conduct of their department of the hospital. Doctor McCarthy said that in his hospital services he always made it a point to specially instruct his people that if a patient complained about treatment, about the bill, etc., every effort should be made to have things corrected or adjusted to suit the patient so that he will want to come back to the hospital and that service.

As to the psychopathic ward, Doctor McCarthy said there was no question at all as to the merit of the suggestion Doctor Guthrie had made. If you have a nervous patient who has never before been to the hospital and if he or she has to wait in the reception room for hours before being taken care of, the patient becomes very dissatisfied, and in some cases may leave the hospital before being admitted to the private room or ward.

He thought the nursing situation was a serious one, and that in psychopathic work especially it was especially essential to have nurses who were properly trained to meet patients, since one without proper training may undo in a few minutes the work which it has taken months to do.

When it was necessary to do a minor operation on a very nervous patient, he would rather not take it to the operating room, but take the chance of infection in the patient's room than have the patient scared to death. It was the neurologists who got the results of the surgical operations,—the post-operative neurasthenics; many times not because the surgeon had failed in his operation but because the preparation and post-operative treatment of the patient had not been properly followed out.

Doctor McCarthy said that he believed that all of Doctor Guthrie's suggestions could be applied to a large city hospital just as well as to a small hospital, but that it would take time and trouble. In most cases it would mean doing to the hospital what the manager does to a hotel if he wants to make it first class; reorganizing from the door all the way through the hospital.

FIG. 1.—Old compound depressed fracture of the frontal bone: a and b, before transplantation of cartilage; c, after transplantation.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 11, 1922

The President, Dr. John A. Hartwell, in the Chair

TRANSPLANTATION OF COSTAL CARTILAGES FOR DEPRESSED FRACTURE OF FRONTAL BONE

Dr. Clarence A. McWilliams reported the case of a miner, aged thirty, who was referred by Doctor Downes, and admitted to the Skin and Cancer Hospital, September 10, 1922, with a marked depression in the left frontal region, extending to the mid-line above the root of the nose, one and one-half inches to the left and down through the supraorbital ridge. The deformity was very marked and there was a partial ptosis of the left, upper eyelid (Fig. 1, a). The history was that in June last he was injured by a fall of slate in a mine producing a compound, depressed, lacerated skull fracture, filled with dirt. He was operated upon in a hospital in West Virginia, the wound was cleaned and spicules of bone removed. The healing was by primary union. When seen by the reporter there was a Y-scar in the centre of the forehead depression where there was cerebral pulsation. He begged to have his deformity relieved, though there were no subjective cerebral symptoms of any kind. So operation was performed on September 14, 1922, under Gwathmey colonic anæsthesia which is the method of anæsthesia employed in the Skin and Cancer Hospital for all head and neck operations. This is a great advance over all methods of inhalation anæsthesia, and we have yet to see an untoward effect from it, and our series of cases using it is large. The Y-incision was opened without going through any unscarred territory. The skin was elevated and it was found that both walls of the frontal sinus were gone, the brain, covered by a fibrous membrane, pulsating at its depth. The bony edges of the depression were freshened, and from the lower right costal arch were removed three pieces of cartilage with perichondrium on one side, whose edges were beveled, and these strips were fitted into the depression, edge to edge, the lowermost strip being curved so as to round out the supraorbital ridge. The strips were sewn in place at their ends by plain catgut. Cartilage was preferred to bone to fill out the depression because:

1. Cartilage is more easy to whittle into any desired shape.

2. Cartilage withstands infection better than transplanted bone. Infection in this region might prove serious. Necrosis of cartilage the result of infection is never as extensive as in a graft of bone.

3. Transplanted cartilage remains permanently in place while probably most transplanted bone undergoes absorption and replacement. No drainage

was used and the wound was sewn up by interrupted silk sutures. The union was by primary intention in both the forehead and the chest. The cosmetic result was excellent. (Fig. 1, c.)

COMPLETE RHINOPLASTY BY CARTILAGE TRANSPLANT AND PEDICLED TEMPORAL FOREHEAD FLAP

Dr. Clarence A. McWilliams presented a girl twenty-two years of age who was cured four years ago of lupus of the face after six years of treatment at the Skin and Cancer Hospital. In January, 1922, she went to Doctor McWilliams to have her deformed nose rectified, if possible. All the cartilages of the nose were gone and there was a large perforation of the septum at its lowest part. The nose was level with the face and the nostrils looked upward. The skin of the nose was scarred deeply. Dr. V. Mitchell took a plaster cast of the face and nose. On this cast was built up of wax a suitable nose. A strip of tinfoil was laid over the new nose and extended over to the right temporal region, its base just above the ear so as to include the anterior temporal artery. This should represent the future temporal flap in the hair line, and was cut just of the right shape.

The patient was anæsthetized with the Gwathmey colonic anæsthesia. After the first anæsthesia, which was perfect, she would have no other method of anæsthesia. Three times she was thus anæsthetized and all worked perfectly. The first procedure was to transplant a piece of costal cartilage between the skin and pericranium in the exact spot in the frontal region in the hair line as measured on the overlaid pattern of tinfoil. This was left undisturbed for two weeks. Then the flap was marked out extending over to the ear and its outer half was tubed; that is, its edges were sutured together. The portion to form the future nose was cut down to bone through the pericranium, except above where it was left uncut to form the hinge upon which the flap was lifted up. The under-surface of the pericranium was Thiersch skin grafted and the flap sutured in place and was left undisturbed for two weeks. Primary union resulted. Then the hinge was divided, freeing the whole flap containing cartilage with skin under surface. The scar tissue of the nose was removed into the nasal cavity, the columella was divided above and the forehead flap pedicled above the ear was brought down and fitted into the nose. The raw columella edge was sutured to the raw area of this flap. For two weeks the flap was left undisturbed. Then it was divided close to the ala and sutured to the freshened nasal edge. The severed outer portion of flap was then replaced in the freshened temporal defect and the raw area in the forehead, made by taking skin for the nose, was skin grafted. Primary union resulted throughout and the final cosmetic result is excellent. The hair on the new nose has been removed by X-rays, applications once a month for six months being necessary to permanently kill hair.

COLONIC ANÆSTHESIA

Dr. John A. Hartwell expressed a desire to know whether all the members of the Society were as enthusiastic about colonic anæsthetization as Doctor McWilliams seemed to be. He said that there is a general impression that

it is not as safe as inhalation anæsthesia, and he thought it would be well for the members to discuss it before letting it go unqualifiedly that it is without danger.

Dr. Edward W. Peterson said that he had used oil-ether rectal anæsthesia in œsophageal diverticula operations with happy results.

Dr. H. H. M. Lyle said that he had used colonic anæsthesia extensively and thought it had its advantages, but he was not sure that it is absolutely safe. He was open to proof either way. He had seen one or two cases in which he had his doubts whether it had not something to do with the patient's death.

Dr. Carl Eggers said he had used colonic anæsthesia as advocated by Doctor Gwathmey, in suitable cases, both at the Lenox Hill and the New York Skin and Cancer Hospital. It is not alone a question whether colonic anæsthesia in general is a safe anæsthesia, but whether it is a safe anæsthesia in those cases in which it is specially indicated. It seems unscientific to inject a fixed amount of ether, the rate of absorption of which one is unable to control. In practice, however, it works out very satisfactorily. By mixing the ether with oil, it is absorbed but slowly and one can usually recover part of the mixture, should it become necessary.

Some years ago when larger amounts of ether were still being used, Doctor Eggers had a death in a young man who had been operated upon for sarcoma of the superior maxilla, who during the operation began to do poorly. He tried to recover the ether mixture, but was not successful. The patient was returned to bed in bad condition. He tried everything to overcome the deep ether anæsthesia, but was unable to prevent a fatal outcome. He had had one other bad result in a patient with chronic empyema. In addition to colonic anæsthesia he was given 300 c.c. of 4 per cent. magnesium sulphate solution by hypodermoclysis. This patient never recovered complete consciousness and died after twenty-four hours. He was autopsied. The wound was allright, but there was œdema and interstitial hemorrhages into the lung, sanguineous fluid in the thorax and an acute exacerbation of a chronic nephritis. The findings were attributed to the anæsthesia. Doctor Eggers did not think Doctor Gwathmey uses this combination at present. The administration of small amounts of ether in oil (4 oz.), as practiced at present gives excellent results, and in head and mouth cases seems an ideal anæsthetic.

It is the speaker's belief that patients with a patent ileocæcal valve are not suited for this form of anæsthesia, because in them the ether oil mixture may pass into a part of the intestines from which it can not be recovered.

Dr. J. I. Russell asked if when this form of anæsthesia was used, whether there was any proctitis or colitis following, and whether the patient was relieved of the nausea which follows inhalation anæsthesia.

Dr. Robert T. Morris remarked that a notable degree of relaxation of the abdominal muscles belongs to colonic anæsthetization. The method has peculiar advantages also in cases of bronchiectasis, bronchitis, and pulmonary tuberculosis.

DR. CLARENCE A. MCWILLIAMS, in closing the discussion, declared that he was greatly surprised at the results of colonic anæsthetization when he first went to the Skin and Cancer Hospital, but now he uses it with the same confidence that he does inhalation anæsthesia. Very little ether is used, on the average only about four ounces, and the result is that one can use it routinely with confidence and recommend it to anyone who has to do face or neck operations. Smaller and smaller amounts of ether have been used and the routine is now four ounces, with proportionately smaller amounts in smaller individuals. As to Doctor Lyle's doubts whether it might not be held responsible for the death of one or two of his patients, the same might be said for inhalation anæsthesia. In reply to Doctor Russell regarding nausea and vomiting, there is almost no vomiting, usually once at the most. The comfort it gives to the patient is very great. The degree of analgesia with semi-consciousness is high as compared with the complete unconsciousness of inhalation anæsthesia. If one avoids rough handling of tissues and loss of blood, one can operate without shock for from four to five hours, as may be required in extensive node dissections of neck. There is a hospital in Virginia where it is routinely used, and the number of their cases is now over 2000 with colonic anæsthesia. Their mortality is no higher than previously with inhalation anæsthesia. Of course it should be used with care, and the method not changed or experimented with.

RECURRENT DISLOCATION OF SHOULDER

DR. JOHN A. HARTWELL presented a man who had been operated upon eleven years previously for a recurrent dislocation of the shoulder. The patient at the time of operation was fifty years old and gave a history that he had dislocated his shoulder twenty-five years previously while at sea. Reduction was not done until two days later. Following that time the shoulder had repeatedly been dislocated with very slight cause. Dislocation had taken place four times during the three months previous to admission. The shoulder was dislocated at the time of admission, it having been thrown out a few hours earlier while simply elevating his hand above his head. The dislocation is of the subcoracoid type.

Operation performed the same day. Incision was made along the anterior margin of the deltoid from the coracoid process over the greater tuberosity outward onto the arm. The incision was carried down to the capsule. The structures were retracted so as to completely expose the capsule on its anterior aspect. No positive pathology was demonstrated. A long incision was made in the capsule from the glenoid downward and outward to its insertion into the neck of the humerus. The inner lip of this incision was then lapped over the outer lip for a distance of one-half inch and sutured in that position to the external surface of the capsule by three mattress sutures of plain catgut. External wound was then closed without drainage and the arm placed in a Velpeau dressing.

Primary union took place and the patient left the hospital in about two weeks. He started to work as a coal shoveler three weeks after the operation and has been engaged in this work ever since. There has

never been a recurrence of the dislocation and he has suffered absolutely no disability in the way of restricted movement at the shoulder joint.

In a second case a different procedure had been followed. The patient was admitted to the hospital on October 28, 1921, and discharged on November 14, 1921. He gave a history of first having dislocated his shoulder nine months previously following a fall, the exact nature of which was not disclosed. Since that time frequent dislocations have taken place from trivial exertion, three such dislocations having occurred during the week preceding his admission. At the time of admission the humerus was in normal position. Patient stated that when dislocation took place the arm was held close to the body with internal rotation, and that the head of the humerus appeared upward and posteriorly under the spine of the scapula. In other words, a sub-spinous dislocation. This seemed so doubtful that the patient was requested to produce a dislocation before the anæsthetic was administered. This he did by throwing his arm suddenly upward and outward, when a typical subcoracoid dislocation took place, which he stated was the same dislocation that he had previously described as being of quite a different nature. He was immediately anæsthetized and an attempt made to keep the dislocation until the incision should reveal its exact pathology. Immediately on the relaxation of the muscle, however, the head dropped back into its normal position. An incision was made 15 cm. in length beginning at a point over the junction of the outer and middle third of the clavicle and following the contour of the shoulder over the anterior third of the deltoid. The fibres of the deltoid were separated and some of the fibres of its clavicular origin divided. By dividing the fibres of the tendon of insertion of the subscapularis, the antero-internal aspect of the capsule was reached. The capsule was opened longitudinally just internal to the biceps tendons, revealing a large tear in the capsule at its interno-inferior junction about one inch from the attachment of the capsule to the neck of the humerus. Working through the artificial opening, three sutures of No. 2 chromic catgut were used to completely close the tear. The operative incision was closed with four sutures of No. 2 chromic catgut and the divided fibres of the subscapularis repaired at the same time. The separated fibres of the deltoid were loosely approximated, a rubber dam drain was placed in the dependent angle of the wound and the skin incision closed with six sutures of silkworm gut. Dry immobilizing dressing applied. Patient sent to ward in good condition.

This approach to a capsular tear in this location was very satisfactory, the sutures being placed without undue difficulty. It has the disadvantages of adding a possible danger of joint infection and of having the tie of the suture within the joint. This, however, may prove an advantage in causing adhesions which will limit somewhat motion and thus help prevent recurrence.

Primary union took place except for a little sero-purulent discharge from the skin wound, culture from which was sterile. Following the operation the patient was instructed to use his arm as much as

possible, only avoiding exaggerated movements of external rotation and abduction.

At the time of discharge, sixteen days post-operation, movement in all directions was approximately two-thirds of the normal. He was last seen on May 7, 1922, up to which time there had been no return of the dislocation. He was doing hard work as a laborer and there was no restriction of motion. So far as Doctor Hartwell is aware this method of repairing a tear in the capsule of the shoulder joint had not been employed. He felt that it was of distinct advantage over other methods of repair in that being inspected from within the capsular rent was very easily seen and accurately closed, which is often very difficult to do when one is working from the external surface of the capsule.

THE EFFICIENT TREATMENT OF ACUTE AND CHRONIC, SIMPLE, TRAUMATIC SYNOVITIS (HÆMARTHROSES AND HYDARTHROSES) BY REPEATED ASPIRATIONS AND IMMEDIATE ACTIVE MOBILIZATIONS WITHOUT SPLINTING

Dr. Clarence A. McWilliams read a paper with the above title, for which see vol. lxxvi, page 677.

Dr. Robert T. Morris said that sometimes the tissues about the joint are painfully distended with serous infiltrates, particularly in the chronic cases. In addition to aspiration, he injects a solution consisting of one part boroglyceride, three parts glycerin, and four parts physiologic saline solution, sending it back through the same needle. This being hygroscopic has the effect of unloading serous infiltrate from the fibrous tissues around the joint by rapid exmosis. Doctor McWilliams referred to the quickness with which these patients get about after aspiration of joints; the speaker had also found that patients wanted to get right out of bed, and he was convinced that one may safely let them get up quickly as a rule.

Dr. Royal Whitman said that the quotation Doctor McWilliams had read from his (Doctor Whitman's) book, namely, that aspiration was always indicated if the tension of the effused fluid caused discomfort, and that functional use was to be encouraged if the joint could be protected by adhesive plaster strapping, made it evident that he was not to be classed with those writers who advocated indefinite fixation in splints regardless of the effusion. Synovitis at the knee or other joint was a symptom of injury, and he could not therefore admit that evacuation of the effusion and immediate functional use was a specific remedy for all cases. Certainly not for a crushed or displaced cartilage, or ruptured lateral ligament. Even in the illustrated case in which blood was removed at repeated examinations and in which there was elevation of bodily temperature, it seemed to him that rest and compression for a few days was indicated rather than enforced function. While, therefore, he was in accord with the principles advocated by Doctor McWilliams, he thought these principles should be applied with discretion and discrimination.

Dr. George Woolsey considered that Doctor McWilliams was a little radical. Aspiration should depend somewhat on the amount of fluid. In

many cases of traumatic synovitis the patient could be made very comfortable by strapping and allowing him to go about at once. Aspiration is not, therefore, always a necessity, and if it is not necessary it should be avoided. There are cases where aspiration is very valuable, but that it should be pronounced a rigorous necessity in all cases would seem questionable. It depends also on the joint. The knee joint is very readily aspirated, but in other joints it is not so easy. Mobilization is proper in all cases. The speaker had used it for many years in cases where the injury went beyond a sprain and produced a peri-articular fracture. He showed a case here some time ago of a man with a fractured patella treated by mobilization, pressure and massage, who was discharged from hospital on the 24th day. At the end of five weeks, when he was shown before the Surgical Section of the Academy of Medicine, function was perfect and the patella was apparently healed. In fracture cases passive mobilization was preferable to active. With these reservations, Doctor Woolsey considered Doctor McWilliams' paper very valuable.

Dr. John J. Moorhead (by invitation) referred also to a quotation, by Doctor McWilliams, from his article on synovitis of the knee, and wished he had a reprint with him so that he could add another page. He expressed his accord with those members of the Society who said that these patients should be selected. In certain types the convalescence could be shortened by immediate aspiration and mobilization, but the speaker was not in favor of aspirating every case of synovitis of the knee.

Dr. John A. Hartwell said he understood Doctor McWilliams to say that coagulation in the synovial fluid might result in a foreign body, and he asked Doctor McWilliams if he would give his authority for believing that such coagulum could result in a foreign body, or " joint mouse."

Doctor McWilliams, in closing the discussion, explained that all he had wished to do in this paper had been to bring out the fact that the routine treatment of synovitis should be aspiration and mobilization. The patients with a large amount of fluid in the joints have very great pain, and the quickest way of relieving them and getting them well is to repeatedly aspirate. He did not think it should be laid down in the text-books that there are two methods of treatment, one of which is as good as the other. There is only one best way and that is aspiration combined with mobilization, and this should be the routine treatment of acute synovitis with fluid. The patient cannot get motion without aspiration because otherwise motion is too painful. Replying to Doctor Hartwell, he had no definite proof about the coagulum, but some of these cases treated with aspiration are so prolonged that it is presumable that this is due to the residuum of the fluid. Doctor McWilliams firmly believed that soon aspiration of fluid in a knee would be considered just as essential as aspiration of fluid in a chest.

CORRESPONDENCE

A POWER-DRIVEN TO-AND-FRO SAW

EDITOR ANNALS OF SURGERY:

Sir:

The foundation of modern bone surgery was laid with the advent of the X-ray. The X-ray has served to give us a definite knowledge of bone topography in both the normal and abnormal state.

The processes of bone regeneration are open to accurate observation and study. The belief in the bone regenerating power of the bone marrow, *per se*, has received a practically unanimous quietus. This conclusion has a forceful demonstration in the inability of the marrow to rehabilitate a bone pin placed in its substance. The bone has been removed and the X-ray shows new bone developing from the osteogenetic layer of the retained periosteum. Fractured bones have been separated only with the periosteum bridging the gap. Heavy deposits of callus following the course of the periosteum indicate the bone regenerating qualities of the periosteum. Severed bones show a reunion on their contacting surfaces. Here we must conclude that regeneration occurs through the functioning of the osteoblasts of the special network of the compact bone.

We have seen the interposition of fibrous or other alien tissue between these osteogenetic structures act as effective barriers to the formation of new bone and union.

An ever present recognition of these underlying facts is essential in all operative processes for bone repair. It is evident that perfect apposition of periosteum and compact bone is the aim and ideal of the operation, since it promises the quickest and best regeneration of the bone.

If there is secured a united and continuous vital periosteum, the prospects for bone regeneration are good. If there is positive contact of healthy compact bone we can expect union. Naturally the more completely these conditions have been met, the more prompt is the union.

Is it not likely that the delayed union extending over many months is due to lower vitality as much as it is to actual scant osteogenetic contact? If there is that fortunate condition that once the bone cells have effected a union, they continue to spread till the physiological demand for an ample union is accomplished.

To secure a prompt union, or in other words to gain an extensive contact of healthy compact bone and a united vital periosteum, our operations must meet these demands. Herein has been the major difficulty. Bone is not soft tissue that can be drawn by suture to perfect coaptation. Periosteum is not readily stripped and preserved. Sometimes scar tissue is preserved with the periosteum when it should be eliminated.

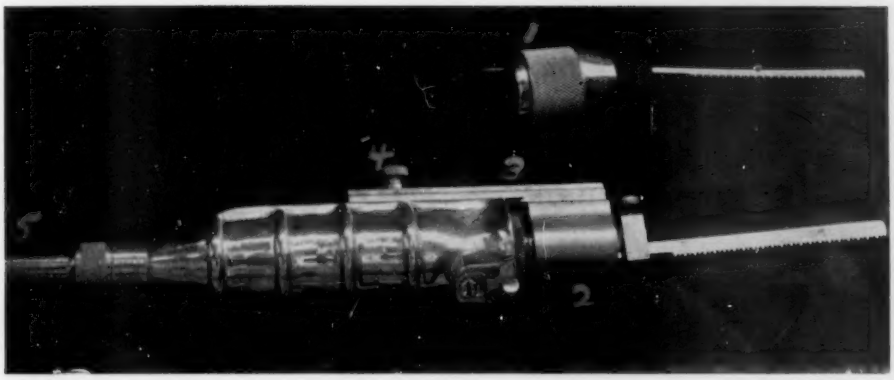

FIG. 1.—A to-and-fro power saw. Instrument can be boiled. 5 connects with the power. To change movement, unscrew 4, slide 3 off, unscrew 2 and attach chuck 1, making rotating holder.

To secure an extensive coaptation of compact bone the hand chisel, the burr, forceps, etc., are crude instruments at the best, since a slight irregularity can prevent a close coaptation of an extensive surface.

The introduction of a power-driven saw making smooth cuts was a real essential and most welcome in the development of bone surgery. Improving our instrumental facilities has been the object of intensive study on my part for some years. The bone equipment I have produced will saw the bone, drill, burr, tap threads, make bone pins, bone screws, etc., all without burning, with a delicate control and with perfect reliability.

A circular saw, however, has its limitations. It will cut through a compact layer, but will not make a smooth, unbroken cut of a bone shaft of appreciable thickness.

To fit the bone ends in a non-union or to cut deformed unions we have had to use the chisel. The need for a smooth accurately cutting implement has prompted me to devise the to-and-fro or linear saw shown in the illustration. (Fig. 1.) As with all instruments, power driven especially, it must be used rightly to get best results. The saw is long enough, strong enough, to cut the femur and naturally any smaller bone. It has a short to-and-fro movement to prevent penetration of the soft tissues. The short stroke is compensated by the rapidity of movement, though this is not sufficient to burn the bone.

The instrument can lie free in the hand running full speed. In cutting, the bone must be held rigidly to prevent losing any of the length of the short stroke of the saw. The instrument is practically indestructible. About the only requirement is to see that the tip of the saw does not catch in the cut in the bone.

The saw is adapted for amputations, for trimming true smooth ends in non-unions, for cutting deformed unions, for making false joints, etc. Where a false joint is desired it is possible to make a slight curve as the saw passes through the bone.

The device transforming the rotary to a to-and-fro movement is readily removed from the regular handle of the equipment. The regular chuck can be attached and we have the simple rotating handle for the various accessory rotating tools.

HARVEY C. MASLAND, M.D.,
Philadelphia, Pa.

COMMENTS ON THE AIR OF SOME SURGICAL OPERATING ROOMS, AND UPON THE PRESERVATION OF THE BODY WARMTH OF PATIENTS

EDITOR ANNALS OF SURGERY:

Sir:

I wish to express my deep appreciation of a recent[1] communication by Mr. J. P. Rowlands, as to the questionable benefit to patient and operator accruing from working in stifling places. Personally, I should just as soon think of performing my morning physical exercise, as of operating, in the poisonous atmosphere of some of the trig parlors now grandiloquently styled

modern operating theatres. I have often wondered if the designers, much less the performers, in these lethal chambers ever ask themselves the question, is such an atmosphere conducive to the bien être of the unfortunate victim, who in all probability, is already saturated with toxins and who is necessarily being doped with an anæsthetic—both of which tend to render him a likely candidate for post-operative acidosis. Deprivation of a free supply of God's fresh air in such a moment of crucial cardiac extension is, in my humble opinion, an act worthy of " sentence " or " the certificate."

In order to obviate misunderstanding, I wish to emphasize that I am all for keeping the patient warm throughout operation—and for this purpose have had my operating tables fitted with suitable electric[2] installations —by which means the patients are kept beautifully warm with the result that shock and post-operative lung trouble are comparatively rare incidents. In parenthesis—the first operating table purchased (1897) by me for the British Hospital, Buenos Aires, contained a large open hot water tank—which, by the way, has now been converted into a commodious receptacle for "an electric resistance." The bodies, above and below operative field, are clothed in wool—and dry sterilized towels do the rest. While three calefaction installations heat the interior—a free supply of fresh air pours in continuously through the six windows (two, most efficient for ventilation, are long narrow ones level with ceiling); in summer time they are often all kept wide open, and in other seasons, the slightest sensation of stuffiness calls forth " open that window," *i.e.* the one which is likely to provide the air without any current or blast which might perturb the solar plexus through undue cooling of exposed intestines. It has been my habit since I commenced (1894) operating to do everything possible to make my body feel as light and airy during a hard morning's work as I wish it to be in the middle of a hard single at tennis or at all square on the 17th green.

As I always have my hair cut short and endeavor to keep my teeth clean and mouth shut,[3] I forego in the way of head gear the immaculate combination of a Turkish Madonna and a French Chef. Keeping a patient warm during operation is somewhat analogous to that of keeping warm in bed during winter—so far I do not know of anything, for this purpose feeling fit and fresh in the morning, equal to sleeping in a room with a large open window (not in a draught) with plenty of warm bed clothes (a thick football Jersey is a valuable item).

Possibly this conclusion may be due to some personal idiosyncrasy—if so, I should be gratified to hear the opinion of those who sleep in a room solely artificially ventilated, or in a room without any ventilation beyond what the crevices of a shut window afford? Or of those who cover the head, mouth and nose with the rest of "it" within the same sheets? The latter being particularly apropos to the context, as it possesses an obvious analogy to the condition of the patient under anæsthesia in a super-heated theatre, struggling for life—half smothered in exhalation and gas.

There is another matter[5] in which Mr. Rowlands and I are in complete accord—but which I hesitate to recommend to operators who are accustomed to work under such pressure, *i.e.* to practise operating to the clock—for fear that the shock of such an academic outrage (!) much less the extra strain it might entail in an atmosphere "which[4] in half an hour causes a person, in normal state of health and strength, to burst into a cold sweat or to acquire a splitting headache," might induce a cerebral disaster.

The use of gloves in delicate visceral operations. While I am a confirmed believer in the regular use of rubber gloves by my assistants and dressers—and personally in septic cases—I should as soon think before entering the drawing-room after a postprandial wash of the hands of trusting the adjustment of my buttons to gloved fingers as to confide separation of intestinal adhesions obscured *e.g.* in the depth of pelvis to the gloved fingers of "the up to date" super-surgeon.

I have been assured by physiologists who have made a profound study of organic tactile sense that even with the interposition of the most delicate foreign membrane between living parts the acuity of perception is greatly diminished—and stimulation to cellular response appreciably inhibited.

JOHN O'CONOR, M.D.,
Buenos Aires, Argentina.

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PRIORITY IN THE EXTIRPATION OF THE GASSERIAN GANGLION

EDITOR ANNALS OF SURGERY:

Sir:

In a paper under the caption, "Surgery of the Trigeminal Tract," published in the Journal of the A. M. A. of October 29 last year, Doctor Frazier of Philadelphia says: "It is within the memory of most of us when J. Irving Mears of Philadelphia in 1881, first proposed the removal of the Gasserian ganglion and when Hartley of New York in 1891 first performed this operation, etc."

The learned doctor is absolutely mistaken. The operation must have been proposed long before the day of Doctor Mears. It was performed in the United States as far back as 1869 by Dr. H. E. Foote, Professor of Anatomy in Miami Medical College of Cincinnati, and one of the visiting surgeons to the Cincinnati Hospital. The patient was a woman by the name of Ellen Carney, a sufferer for many years from neuralgia of the nerves of the upper and lower maxillary regions. In the year named I was one of the resident physicians of the hospital referred to, and at the time in charge of the service of Doctor Foote.

The case presents several interesting points. The operation was done on a Saturday morning, was begun about twelve noon, and finished at 2 P.M. It was attended by Doctor Dawson (a well known surgeon), who assisted Doctor Foote, and a number of other surgeons and physicians connected with the hospital. As the interne in charge of the service I administered the anæsthetic, chloroform, in the simple fashion then in vogue.

There was no thought of asepsis or antisepsis (no sterilizing of instruments, no preliminary scrubbing and disinfecting of the hands of the surgeons, etc.). All that was done was to pour a little carbolic acid into the warm water in the tray in which the instruments lay.

The cavity left in the superior maxillary was filled with small pieces of sponge cut from a larger sponge which had lain in the carbolized water in the tray, and the wound was closed with several layers of gauze bandage wound around the head. At the close of the operation I was instructed by Doctor Foote to remove the sponges on the following morning (he did not visit the hospital on Sunday).

On my night round I found the patient in the condition she was in when brought from the operating room, apathetic, listless, cold, pulse feeble, hardly perceptible. The next morning I found her still under the influence of the shock and did not remove the sponges. About 1 P.M. I was hurriedly summoned to the ward; the patient was sinking rapidly I was told. I hastened to the bedside and found the patient going fast; her hands cold and clammy, her feet like ice, body cold, eyes with a glassy stare and almost breaking. I realized that no time was to be lost here if the patient was to be saved. We always had hot milk in the ward kitchenette, so I bade the nurse bring it in. She brought an oyster-soup-bowl about three quarters full. I added to this about three ounces of whiskey, opened the patient's mouth and managed to let the lacteal fluid down her œsophagus. it had some effect—seemed to bring her to, somewhat. Ten minutes later I repeated the dose. Fifteen minutes after this I gave a third dose and in half an hour after this a fourth one. The patient was very much better, but she was still very weak, and there was a tendency to relapse into the state of collapse. To make a long story short, till 1 A.M., during all of which time I stayed with the patient, I gave her ten such doses. At that hour, feeling satisfied that the crisis was over and the patient on the road to health, I retired to rest. The next morning (Monday), as I made my round, I found the patient quite bright and fairly vigorous, and when the surgeon made his visit he removed the sponges and as he inspected them he remarked, "Not a sign of pus." The woman made a quick and uneventful recovery. I saw her several years later and she still complained of pain along the inferior maxillary, though she was much better, free from the horrible sufferings she had endured before.

I am certain that the milk and whiskey filled her blood-vessels with the warm nutrient and stimulating fluid, and thus stirred up and gave

strength to the lagging heart and saved the patient. Not all the stimulants of the Pharmacopœia could have done it. Furthermore there can be no doubt but that it was the whiskey so freely administered that saved the patient from infection, as it destroyed all septic elements both in the blood and in the wound. That this must be so is clearly demonstrated by the fact that in those days, which were the days of pus lore, every operation was followed by suppuration, and that abdominal operations were not attempted at all, at least in this hospital, because of the great fatality that attended them.

The history of this case can be found in the records of the hospital for the year named.

HENRY ILLOWAY, M.D.,
New York City.

THE ESSENTIAL FEATURE OF THE ABDUCTION TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR

EDITOR ANNALS OF SURGERY:

Sir:

I note that Doctor Wilensky in his interesting paper on immediate operation for fracture of the neck of the femur refers to the "plaster treatment" and to its various modifications by Whitman, Mixter and Moore. What he really has in mind, I infer, is the abduction treatment and its modifications. He defines the treatment, however, as the "immobilization of the fracture in plaster," and it is evident that the outward and visible sign of the plaster spica has made more impression on him than the inward and spiritual grace of which it is merely the manifestation. As he shares this conception with many others, I shall take this opportunity to point out the vital distinction between internal, or natural, splinting and that dependent upon external appliances.

The abduction treatment differs from all others in that it utilizes the mechanics of the hip joint to correct resistant deformity by natural leverage, and to fix displaced fragments by capsular tension and bony resistance. To assure the internal splinting the limb must be fixed in complete abduction and extension, and for this subsidiary purpose a plaster spica is used, not because it is an essential part of the treatment, but because it is the most available, and when properly applied the most comfortable appliance at command.

The abduction method is the exponent of radical reform simply because it applies the surgical principles that govern the treatment of all other fractures. It was introduced to the profession twenty years ago, at a time when it was taught that the intracapsular fracture could not unite, that the deformity of the so-called impaction should not be corrected, and that the treatment of the fracture as a fracture was in most instances dangerous and futile, therefore, that "restoration of form and function was rarely to be attempted or even sought"; when treatment in three of the leading hospitals in New York was characterized by an investigator as worthless, and when, according to the report of the British Committee, in but 23 per cent. of the cases of fracture of

the neck of the femur actually treated could the results be classed as satisfactory.

The experience of the past twenty years has demonstrated conclusively that in the great majority of cases, fracture of the neck of the femur, in competent hands, may be treated like other fractures, and that, relatively speaking, the results compare favorably with those of other fractures in patients of the same class.

Doctor Wilensky thinks that, of fractures within the capsule "when treated badly or inefficiently" not more than 10 or 15 per cent. will unite, and since the fracture is inefficiently treated by the average worker, this percentage may be accepted as representative.

He concludes, therefore, that these fractures may be treated with advantage by primary bone pegging, the inference being that bone pegging will always be performed by experts, and that it will always be successful.

It seems to me, that, if this percentage actually represents the results obtained by the average worker, that the average worker should no longer treat fracture of the neck of the femur. Furthermore, that since the abduction method is the only means by which the fragments of the intracapsular fracture may be brought end to end and forced into resistant contact, the surgeon who does not avail himself of this means to provide the opportunity for repair should be held responsible for the result, not because opportunity will always assure success, but because the lack of opportunity for which he is responsible makes failure inevitable.

ROYAL WHITMAN, M.D.,
New York City.

TRAUMATIC PANCREATITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the October, 1922, number of ANNALS OF SURGERY in an article on "Traumatic Pancreatitis" by myself, I quoted from an article by Dr. Stuart in *North West Medicine*. This article was written by Dr. C. Stuart Menzies, of Portland, Oregon, and through an error made by *North West Medicine*, the latter part of his name was omitted.

Will you please make correction, and give the credit for the article quoted, to its author, Dr. C. Stuart Menzies?

EARLE DRENNEN, M.D.,
Birmingham, Ala.

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